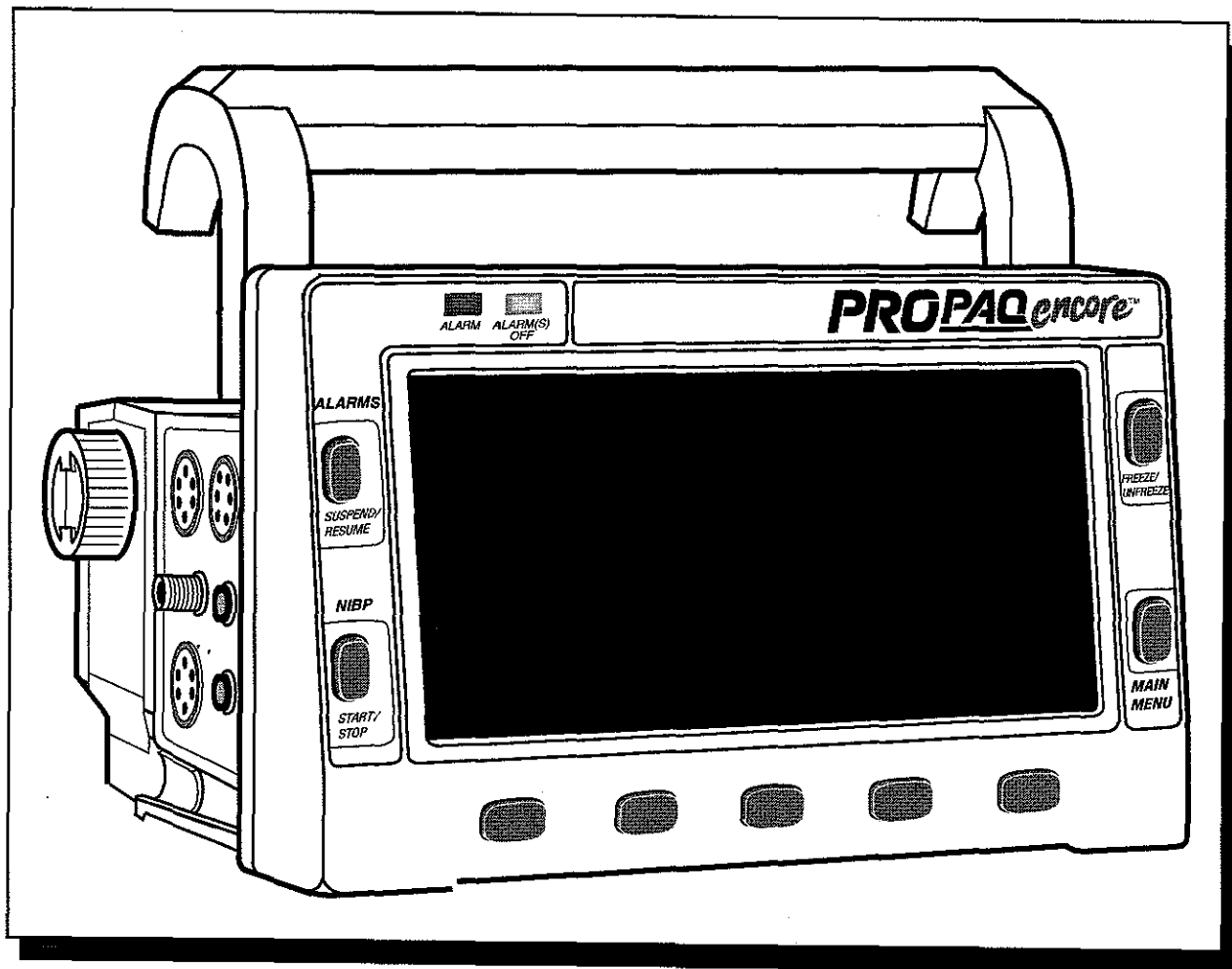


PROPAQ*encore*[™]

Service Manual



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For information regarding this document or any Protocol Systems product, contact one of the following.

In the United States and Canada:

Protocol Systems, Inc.
Customer Service
8500 SW Creekside Place
Beaverton, Oregon U.S.A 97008-7107
Telephone: 503 526 8500
Toll free in the United States: 800 289 2500
Worldwide facsimile: 503 526 4200
Technical Service Dept.: 800 289 2501
Technical Service facsimile: 503 526 4910
Technical Service Internet E-mail Address: solutions@protocol.com
Technical Service World Wide Web Access: <http://www.protocol.com/service>

Protocol Systems, London, England:

Hartmann & Lotz
Harewood House
Wherwell Road
Longparish, Hampshire SP11 7AH
England
Telephone: 44 1264 72 08 28
Facsimile: 44 1264 72 05 14

Protocol Systems, München, Germany:

Hartmann & Lotz
Bretonischer Ring 16
D-85630 Grasbrunn/Technopark
Germany
Telephone: 49 89 460 70 80
Facsimile: 49 89 460 80 87

Protocol Systems, Paris, France:

Hartmann & Lotz
42, Avenue Montaigne
F-75008 Paris
France
Telephone: 33 1 53 67 52 64
Facsimile: 33 1 53 67 52 63

Protocol System, Asia/Pacific:

Level 17, Price Waterhouse Centre
119 Armagh Street
Christchurch 1
New Zealand
Telephone: 64 3 37 94 429
Facsimile: 64 3 37 92 374

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Safety Summary

This Safety Summary should be read by all Propaq Encore users. Specific warnings and cautions will be found throughout the documentation where they apply.

Caution: Federal (U.S.A.) law restricts this device to sale, distribution, or use by or on the order of a licensed medical practitioner.

Important Safety Considerations

Please consider the following safety points when using the Propaq.

- Place the Propaq Encore and accessories in locations where they cannot harm the patient should they fall from their shelf or mount.
- Do not connect more than one patient to a monitor. Do not connect more than one monitor to a patient.
- Do not use the Propaq Encore in an MRI suite or a hyperbaric chamber.
- Do not autoclave the Propaq Encore. Autoclave accessories only if the manufacturer's instructions clearly approve it. Many accessories can be severely damaged by autoclaving.
- Inspect the power adapter cord periodically for fraying or other damage, and replace the adapter as needed. Do not operate the apparatus from mains power with a damaged power adapter cord or plug.
- Make frequent electrical and visual checks on cables and electrode wires.
- Avoid electrosurgery burns at monitoring sites by ensuring proper connection of the electrosurgery return circuit so that the return paths cannot be made through monitoring electrodes and probes.
- During defibrillation, keep the discharge paddles away from ECG and other electrodes, as well as other conductive parts in contact with the patient. Avoid contact with any accessories connected to the Propaq's left side panel.
- To ensure patient safety, the conductive parts of the ECG electrodes (including associated connectors) and other patient-applied parts should not contact other conductive parts, including earth ground, at any time.
- Do not operate this product in the presence of flammable anesthetics. Explosion can result.



Within certain governmental jurisdictions, all interconnected accessory equipment must be labeled by an approved testing laboratory. After interconnection with accessory equipment, risk (leakage) current and grounding requirements must be maintained.

- To ensure conformance to risk (leakage) current requirements when operating from an ac mains power source, use only a Protocol Systems' 503-0054 series power adapter.
- To ensure patient safety, use only accessories recommended or supplied by Protocol Systems, Inc. For a list of those accessories, see the *Protocol Products and Accessories* book that accompanied this manual (PN 810-0409-XX). Accessories must be used according to your hospital's standards and the manufacturer's recommendations. Always refer to the manufacturer's directions for use.
- A product that has been dropped or severely abused should be checked by qualified service personnel to verify proper operation and acceptable risk (leakage) current values.
- If the monitor detects an unrecoverable problem, an error message window appears containing an error number and a short message. Report such errors to Protocol Systems.
- The Propaq Encore should be serviced only by a Protocol Systems service technician while under warranty.

Definitions



NOTE statements in the service manual, which look like this, identify information that may be important to the reader.



CAUTION statements in the service manual, which look like this, identify conditions or practices that could result in damage to equipment or other property.



WARNING

WARNING statements in the service manual, which look like this, identify conditions or practices that could result in personal injury.

Symbols

The following symbols appear in the Propaq documentation and on Propaq labels. These internationally recognized symbols are defined by the International Electrotechnical Commission, IEC 878 and IEC 417A.



Off (Standby).



On.



For continued fire protection, use only the specified fuse.



Direct current.



Battery charging when green indicator illuminated.



Input port to monitor.



Signal output port from monitor.



Two way communication port.



All patient connections are Type CF, isolated for direct cardiac application, and protected against defibrillation.



Caution: Refer to Reference Guide and accompanying documentation.



Temperature sensor input.



Enclosure Protection Drip proof: Classification IPX1 per IEC Publication 529.



Alternating current.



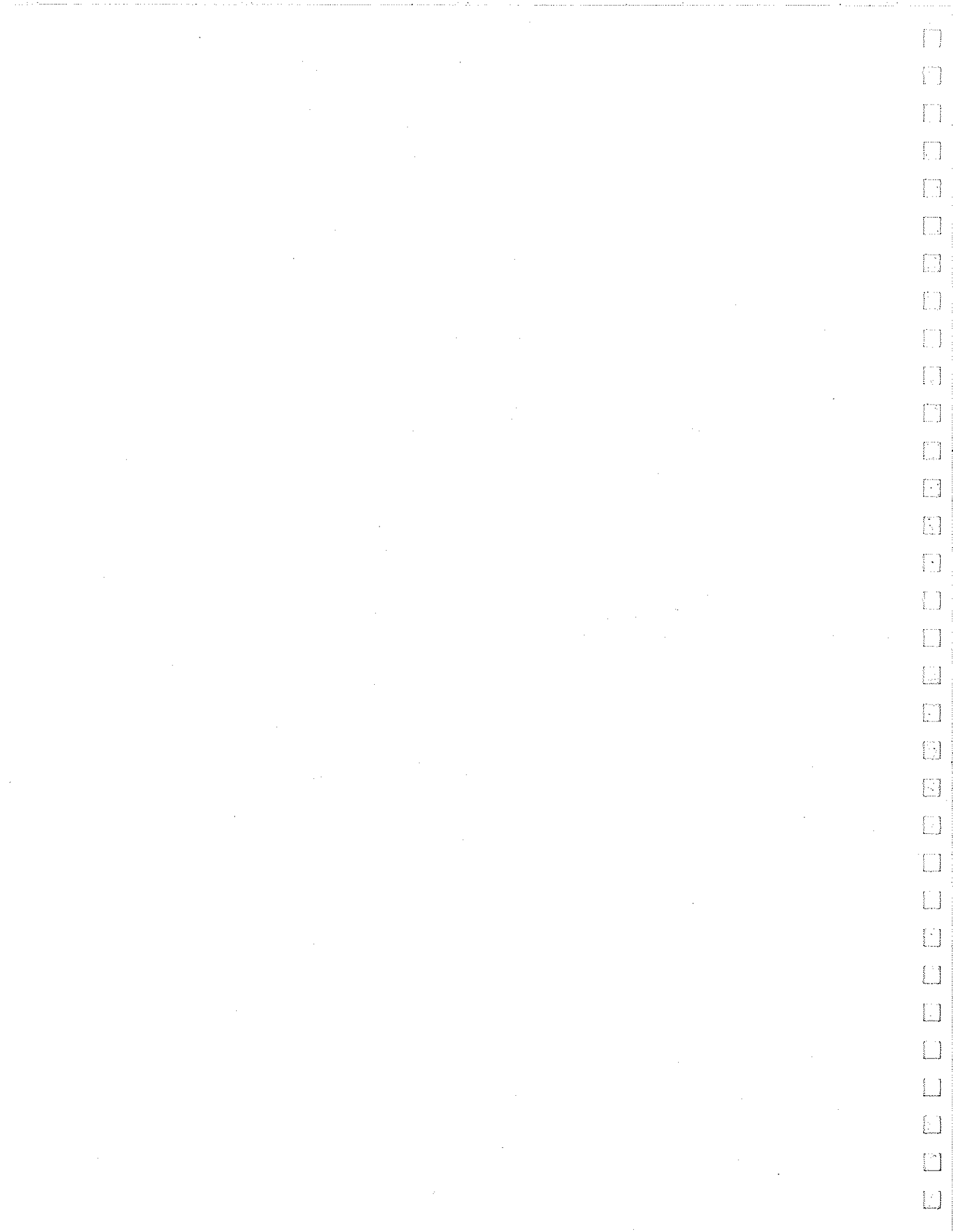
For indoor use only (on power adapter only).



Transformer meets requirements of a short-circuit-proof safety-isolating power transformer.

CE₀₁₂₃

The CE mark and notified body registration number signify Propaq Encore 200 Series monitors have met all essential requirements of European medical device directives 93/42/EEC.



Section 1 Overview

Purpose and Scope

The Propaq Encore Service Manual is intended as a reference for monitor maintenance and repair to the field replaceable unit (FRU) level. FRUs are listed in Section 7. This manual provides the technically qualified service person with troubleshooting information, repair procedures, and calibration and performance verification instructions. A technical overview of the monitor subsystems is provided as an introduction to the device's circuitry and pneumatics.



Configurations vary nationally. Some early versions of the Propaq Encore do not include impedance pneumography (RESP) in some countries.

This manual is intended for the technically qualified service person. Service training classes on Protocol Systems' products are available. Contact Protocol Technical Service for information.

Other Applicable Documents

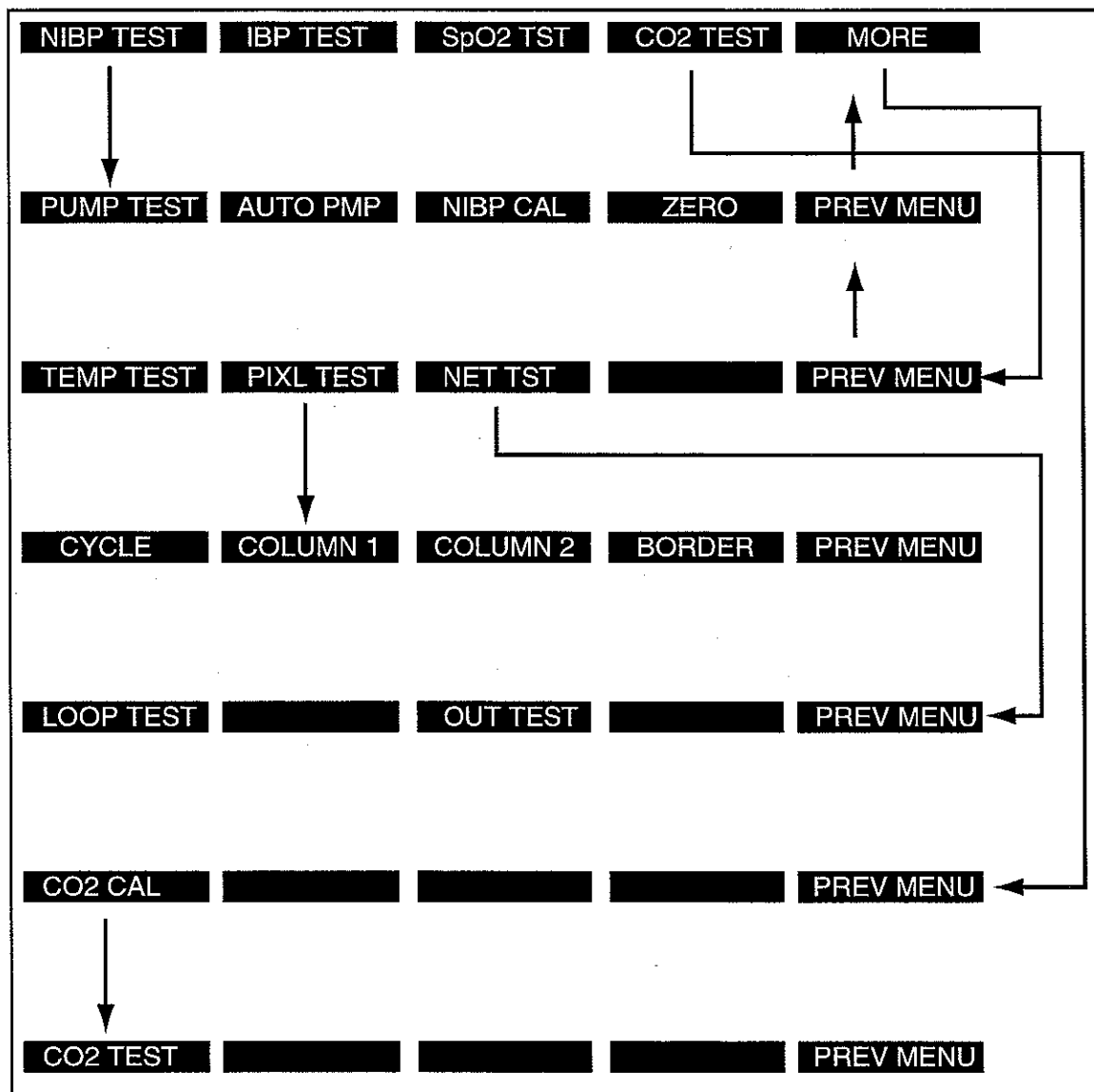
Several other documents are available for the Encore monitor. Refer to those documents for other than maintenance and repair information. Check the *Encore Reference Guide* for information on other user's documentation.

Title	Part Number
Propaq Encore Reference Guide, English Language, U.S.	810-0639-XX
Propaq Encore Reference Guide, English Language, International	810-0640-XX
Propaq Encore Reference Guide, German Language	810-0641-XX
Products & Accessories Book	810-0409-XX

The procedures in this manual indicate which buttons to push by separating each button menu name with the (>) character. For example, to access the Service Menu, the procedures would indicate for you to press SETUP > MORE > MORE > SERVICE > YES, which means you press the SETUP button, then the MORE button, then the MORE button, then the SERVICE button, and finally the YES button.



The figure illustrates all Service Menu functions. Some of these functions are not available if you do not have the appropriate option.



Section 2

Functional Verification

Introduction

The functional verification procedures ensure proper operation of the Encore monitor and its options. These procedures should be performed following module-level repairs, calibration, or whenever there is a question about the accuracy or safety of the patient functions.

The calibration procedures in Section 3 should be used to return the monitor to operation within its performance specifications. If the monitor does not pass the functional verification, or when it is time to do a routine calibration, see Section 3.



WARNING

Whenever the monitor is opened for calibration or repair, a risk (leakage) current safety check as well as a dielectric strength integrity (hi-pot) test must be performed as described in this section.

The Encore's service menu facilitates the functional verification. It has several features for testing and verifying the NIBP (cuff) channel, display, invasive pressure channel, and printer. Refer to Section 1 for information about the Service Menu.

Self Tests

Many functions, such as alarms, waveform and scale sizing, and printer control, are software operations. During the monitor's power-up self-test, the integrity of all programming is checked first. If software testing is successful, hardware tests are initiated. If all testing is successful, the monitor is ready for use. (See Section 4 for information on error messages.)

Required Equipment

You will need the following equipment to verify that all functions of the Encore operate correctly. All test equipment must be calibrated to function within parameters specified by the manufacturer, and must be traceable to a national calibration standard.

Some equipment can be manufactured. See Appendix A for information on manufacturable test equipment.

Required Equipment

Description
0 to 300 mmHg Mercury-column manometer, or calibrated pressure meter, with inflation squeeze bulb
50 MHz triggered sweep oscilloscope
Variable dc power supply, 0-28 V, 3A with voltage and current metering
Patient simulator, Dynatech/Nevada 213A, 214A, 215A, or 217A with IBP, Temperature, and EGG Cable/Leads
Adult cuff (provided with monitor); Neonatal cuff #3; 3 cm diameter solid cylinder; solid cylindrical object about the size of an adult's arm
Protocol cuff calibration kit, Protocol PN 008-0012-XX
Power supply adapter cable, Protocol PN 008-0290-00
Physio Control LifePak 5 or LifePak 6s with appropriate Protocol Systems Defib Sync adapter to use as Defib Sync Marker pulse source
Propaq ac power adapter (provided with the Encore)
Safety analyzer, Dynatech/Nevada, 431F-1D or equivalent
Rod-L Model M100AVS5 high-voltage potential (hi-pot) tester, or equivalent
Static-free work area
NELLCOR pocket tester, PT-2500
Test gas source: dry 4% to 10% CO ₂ , balance air (with flow meter). Gas may be between 4% and 10%, but exact CO ₂ concentration must be certified to ± 0.01 . (Convert percentage to partial pressure (mmHg) as instructed in Section 2.)
Two rubber test tube stoppers, with 1/8" to 1/4" holes drilled through (for CO ₂ tests)

Safety Tests

The following two safety tests, a risk (leakage) current safety check and a dielectric strength integrity (hi-pot) test, must be performed whenever the Encore has been opened for calibration or repair.



A hi-pot test is only required if the monitor has been opened.

Risk (Leakage) Current Test

A risk (leakage) current test must be performed to verify that the patient remains electrically isolated from the power circuits of the Encore.

Check leakage currents using a Dynatech/Nevada 431F-1D safety analyzer or its equivalent. The source current should not exceed 10 μ A rms. The sink current, measured between the isolated patient connections (ECG) and the dc power input connector of the monitor, should not exceed 20 μ A rms. See the analyzer's operator's manual for the proper safety check procedure.



Because of the all-insulated construction of the monitor, an Enclosure Leakage Current Test to ground is not necessary.

Electrical Connections for Patient Risk (Leakage) Current Safety Tests

Safety Test	Power Adapter	Monitor dc Input	Monitor Cable	Safety Analyzer
Source current	Plugged into analyzer outlet	Connected to power adapter	RA LA LL C RL	RA LA LL C RL
Sink current	Not used	Connected to ground connector on analyzer	RA LA LL C RL	RA LA LL C RL

Dielectric Strength (Hi-Pot) Test

Because of the close spacings of the monitor's internal components and the critical positioning of the insulation sheet within the monitor, Protocol Systems, Inc. recommends that a dielectric strength test be performed following any procedure in which the monitor is opened.



WARNING

The Hi-Pot test is extremely hazardous. Only qualified service personnel should perform this test. Conduct the test only on an insulated table top, away from other people and equipment.

Use a Rod-L Model M100AVS5 high-voltage potential tester, or equivalent. Refer to the Rod-L instruction manual for operating information and safety recommendations.

1. Set the high voltage potential of the tester as specified in the table below.

Summary of Connection Points and High-Voltage Test Potentials

Tester's high-voltage terminal connection	Tester's grounded return connection	High-voltage test parameters
All ECG leads on patient cable connected together	DC input connector; all pins connected together	Output: 4000 V ac rms Current Limit: 2.5 mA Ramp-up: 8 seconds Dwell: 1 second

2. Connect the high-voltage output lead of the tester to all ECG leads, using a dedicated patient cable reserved for use only in such tests.
3. Connect the tester's chassis-connected return lead to the monitor's dc input connector, using a suitable plug.
4. Apply the test voltage for one second. The tester must not indicate dielectric breakdown.



WARNING

If any dielectric breakdown occurs, do not use the monitor. All internal sheet insulation barriers must be properly installed. Check the monitor to determine the cause of dielectric breakdown; then repair the monitor or return the monitor to Protocol Systems for repair.

Functional Verification

The functional verification must be done only when the monitor is fully assembled. If the monitor has been stored for longer than one month without the monitor connected to the ac adapter (for recharging), the battery voltage must be checked. The battery must be replaced if it cannot hold a charge. Refer to Section 4 for a battery capacity test.



Some configurations of the Encore monitor do not include impedance pneumography (RESP) and other neonatal monitoring parameters. In these versions, RESP does not appear in menus or on the screen displays. You can ignore RESP and other terms relating to neonatal monitoring when indicated in the following instructions.

If you plan to use a Dynatech/Nevada model 213A, 215A, or 217A Patient Simulator to simultaneously simulate ECG and invasive blood pressure, see Appendix B for important information.

Before starting the verification procedures, charge the battery for at least 8 hours with the monitor turned off. (Charge for 12 hours if a Printer or SpO₂ module is attached.)

Power System

The following steps check the integrity of the Encore's power system.

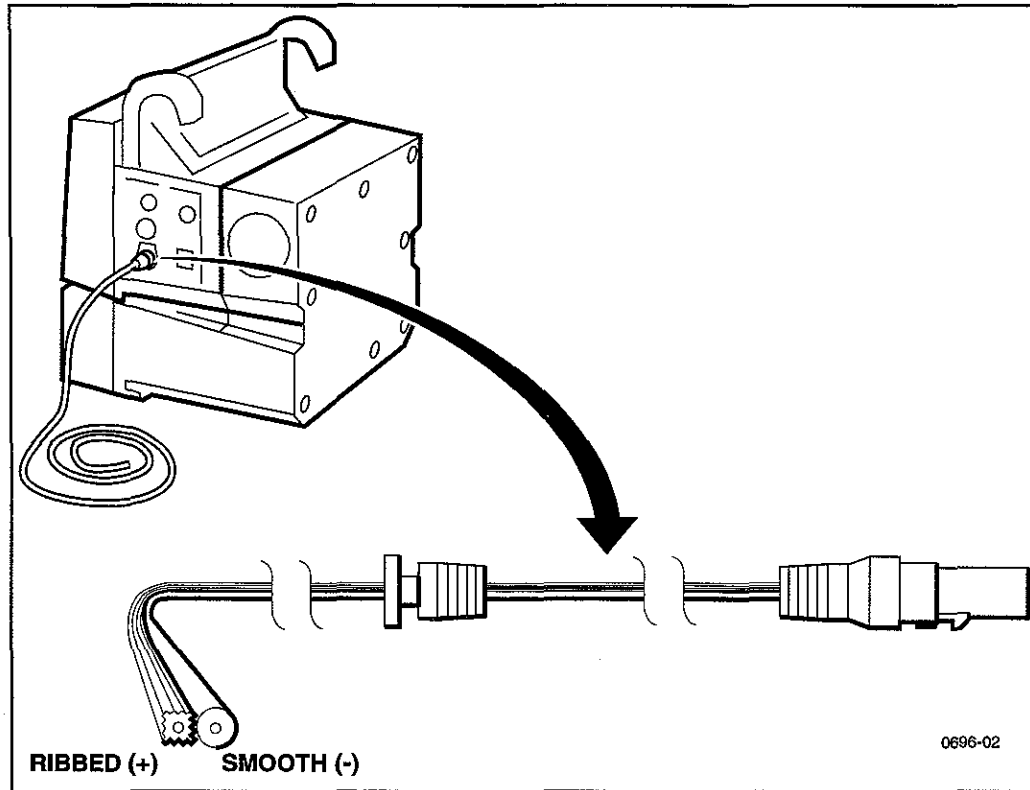
1. Turn the ac power adapter's power switch off.
2. Plug the ac power adapter into an ac mains receptacle and connect it to the Encore's right side panel dc power connector.
3. Check that the green LED charging indicator on the monitor's right side panel is off.
4. Turn on the power adapter's power switch.
5. Check that the green LED on the power adapter turns on and that the green LED charging indicator on the monitor's right side panel turns on.
6. Disconnect the power adapter from the monitor. Check that the monitor's green LED charging indicator on the right side panel turns off.



In the next steps, carefully check for the proper polarity of the connection between the power supply and the monitor. If voltage is applied with the wrong polarity, it will open the right side panel fuse (F1). Refer to the figure on page 2-6 to verify proper polarity.

7. Set the dc power supply meter to Volts and turn the power switch on; set it for 15.0 V \pm 0.1V.
8. Turn off the dc power supply.

9. Using the Protocol dc power supply adapter cable, refer to the figure below for polarity and connect the dc power supply to the monitor's dc input connector on the right side panel.



10. Turn on the dc power supply.
11. Check that the green LED indicator lights up.



Initial charge current for a low battery is higher than for a charged battery. As the battery charges, the current will decrease. The current draw may slowly drop the longer the dc supply is connected to the monitor.

12. Switch the dc power supply meter to current and check that the current draw from the supply is less than 1.8 A.
13. Vary the power supply from 12 V to 28 V and verify that the charging LED stays on.
14. Turn off the power supply.
15. Disconnect the supply from the monitor.

System Tests

The following procedures check that the buttons operate properly, that the display works correctly, and that the date is correctly displayed.

1. Turn on the monitor.
2. Verify that no error messages appear and the monitor correctly powers up.
3. Press SETUP > MORE > MORE > SERVICE > YES > MORE > PIXL TST to test the display.
4. Press CYCLE three times, each time verifying that no pixels are missing.
5. Press MAIN MENU twice.
6. Press SETUP > WAVE SEL > INSERTV to access the inservice features. This generates simulated waveforms.
7. Press MAIN MENU.
8. Press the following buttons in sequence and verify that the monitor responds as indicated and the buttons do not stick.

Press	Result
FREEZE/UNFREEZE	Freezes the waveforms
FREEZE/UNFREEZE	Unfreezes the waveforms
SETUP	Changes the menu
ALARMS	Changes the display
SUSPEND (on menu)	SUSPEND changes to RESUME
ALARM SUSPEND/RESUME (button)	Changes RESUME to SUSPEND
ALL ALARM	Changes display
LIMITS	Changes display
NEXT	Moves cursor block
MAIN MENU	Returns to the main menu
NIBP START/STOP (button)	Starts the NIBP pump
NIBP START/STOP (button)	Stops the NIBP pump

9. Press ECG/RESP > MORE. Then press CHANGE to select the four HR/PR TONE levels. Verify that the tone volume changes and goes off when turned OFF. Set the volume to LOW.
10. Press MAIN MENU.
11. Press SETUP > MORE > MORE > TIME/DAY and check that the displayed time and date are correct.

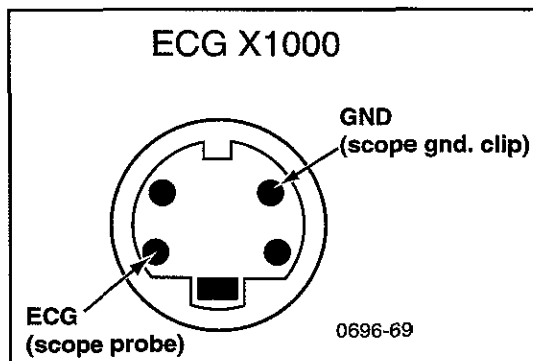
If incorrect, press NEXT and UP or DOWN to select and change the time and date, and then set by pressing the ENTER button. Select the PROGRAM menu (press PREV MENU > PROGRAM), then press DEFAULT to program the new time and date.
12. Turn off the monitor.

ECG/RESP Channel & Alarm Indicators

The following procedures verify the ECG channel and the alarm indicator drivers.

1. Turn on the monitor and verify that it powers up correctly.
2. Connect the ECG channel to the patient simulator using all five ECG leads.
3. Set the patient simulator as follows:
 - ECG Waveform: normal sinus rhythm
 - ECG Rate: 80 beats per minute (bpm)
 - ECG Size: 1 mV amplitude
 - Resp Lead: Lead I
 - Resp Baseline Impedance: 1 K Ω
 - Resp Rate: 40 breaths/minute (br/m)
 - Resp Breath Amplitude: 1.0 Ω
4. Set the monitor as follows:
 - Respiration ON (ECG/RESP > MORE; select and set RESP to ON)
 - ECG Lead: Lead II (ECG/RESP > ECG LEAD)
 - Respiration Lead: Lead I (ECG/RESP > MORE then select the lead and change as necessary)
 - ECG Size: 1 mV (ECG/RESP > ECG SIZE)
 - Resp Size: 8X (ECG/RESP > RESP SZE)
 - ECG Sweep: 25 mm/Sec (SETUP > MORE; select and change HR/PR sweep as necessary)
 - Alarms: All alarms OFF (SETUP > ALARMS > ALL ALARM until all alarms are off except for the Apnea alarm, which cannot be turned off)
5. Press the FREEZE/UNFREEZE button to freeze the waveform.
6. Check that a normal sinus rhythm ECG waveform is displayed with a peak-to-peak amplitude of 10 ± 1 mm. There should be a soft beep tone with each QRS event.
7. Check that the displayed respiration peak-to-peak amplitude is 12.5 ± 1 mm.
8. Press FREEZE/UNFREEZE to unfreeze the display.
9. Check that the monitor's heart rate display is 80 ± 4 bpm.
10. Disconnect the LA ECG lead wire from the simulator.
11. Check that an equipment alarm occurs. The LEAD FAIL message should accurately indicate the removed lead.
12. Press any button to acknowledge.
13. Disconnect the LL ECG lead from the simulator.
14. Check that an equipment alarm occurs and a MULTIPLE LEAD FAIL message is displayed.
15. Press any button to acknowledge.
16. Reconnect all leads.
17. Check that the ALARM(S) OFF light is on.
18. Press SETUP > ALARMS > STAT SET to automatically set heart rate alarm limits.
19. Check that the ALARM(S) OFF light is off.
20. Set the patient simulator heart rate to 180 bpm or higher.

21. Check that an alarm violation occurs causing the tone to sound and the ALARM light to turn on.
22. Press the ALARM SUSPEND/RESUME button and verify that the tone turns off.
23. Press MAIN MENU.
24. Set the patient simulator heart rate to 80 bpm.
25. Set the patient simulator to provide pacer signals.
26. If the pacer indicator is not on, press ECG/RESP > MORE and select and change the pacer setting.
27. Check that a dashed vertical line is displayed on the ECG waveform each time a pacer pulse occurs.
28. Set the oscilloscope to 0.2 second/division sweep and 0.5 Volt/division amplitude.
29. Insert a short piece of thin conductive wire into each of the ECG X1000 connector holes shown in the figure below.

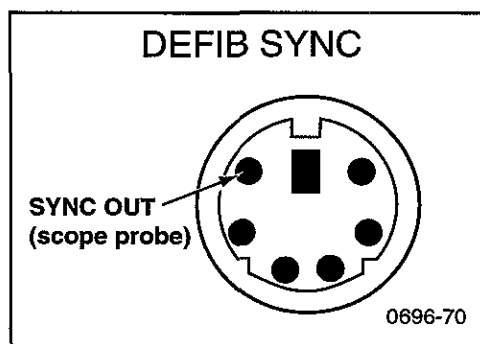


30. Connect the scope probe and the scope ground clip to the wires.
31. Check that the scope displays an ECG signal with an amplitude of $1\text{ V} \pm 100\text{ mV}$ baseline to peak of R-wave.



Some amount of mains noise may also be present in the signal.

32. Move the wire and scope probe from the ECG pin of the ECG X1000 connector to the DEFIB SYNC connector pin shown in the figure below. Leave the scope's ground clip where it is.



33. Change the vertical sensitivity of the scope to 1 Volt/division.
34. Check that the scope displays a 5 V p-p pulse with a 100 ± 5 ms width.
35. Disconnect the scope probe and ground clip and remove the wires from the connectors.
36. Using either a LifePak 5 or LifePak 6s and appropriate Protocol adapter, set up the monitor and defibrillator according to instructions provided in the *Defib Sync User's Guide*.
37. Check the monitor display for sync markers on the ECG waveform.
38. Disconnect the defibrillator from the monitor.



If the patient simulator does not also provide an appropriate ECG signal, the heart rate value will be displayed as --- and an alarm violation will occur.

39. Disconnect the ECG cable from the monitor. (Disconnecting an active channel initiates an equipment alarm; press any key to acknowledge the discontinuance of ECG monitoring.)

IBP

The following procedure verifies the operation of the invasive blood pressure channels. Some models of the Propaq Encore have no IBP channels; skip this procedure if your Encore does not support IBP. If your Encore has multiple IBP channels, repeat the verification procedure for each channel.



Many blood pressure simulators are not intended to be used as calibration standards. Use only the blood pressure simulators specified in the Required Equipment table on page 2-2.



If you are using the Dynatech/Nevada model 213A, 215A, or 217A patient simulator, do not simultaneously monitor ECG and invasive blood pressure (IBP) unless the modification to the simulator is performed as described in Appendix B. If you do not wish to modify your simulator, use ECG and IBP independently.

1. Press SETUP > WAVESEL and check that the P1 and P2 waveforms are turned on.
2. Connect the IBP cable from the patient simulator to an IBP input jack on the left side panel of the Encore.
3. Set the simulator output pressure to 0 mmHg.

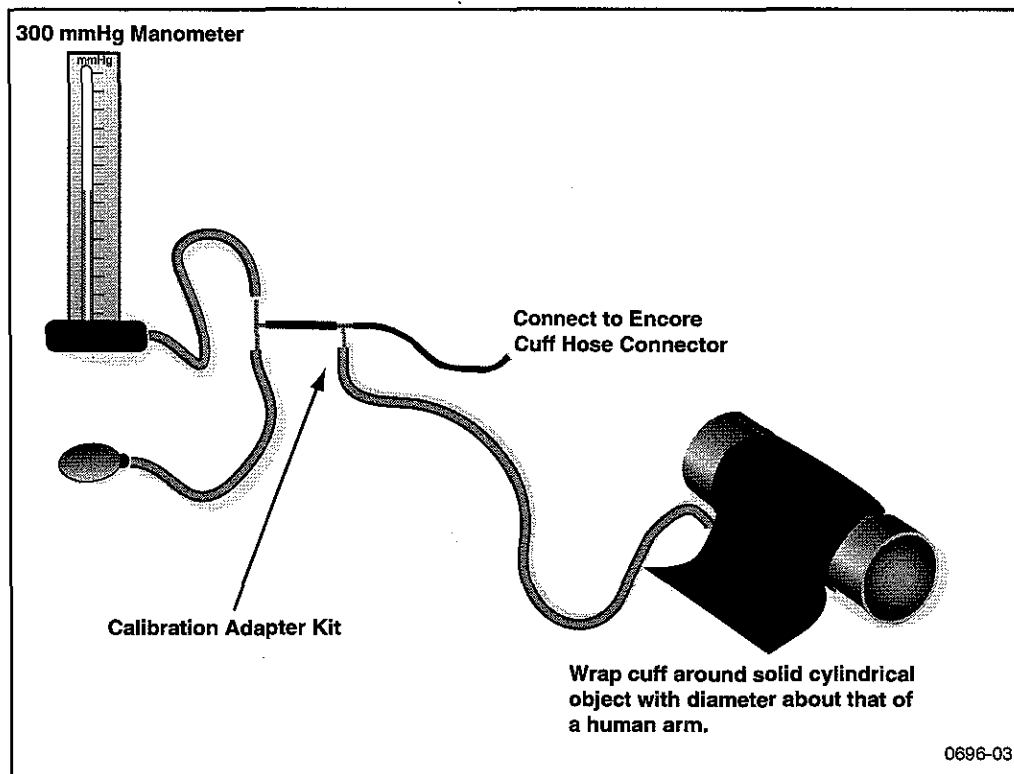


If an alarm tone sounds, press the SUSPEND/RESUME button.

4. Zero P1 by pressing ZERO P1.
5. Check that ZEROED is displayed.
6. Press RESCALE.
7. Check for a noise level of ≤ 3 mm.
8. noise on the IBP waveform.
9. After allowing a few seconds for settling, check that the mean pressure reading is 0 mmHg ± 1 mmHg.
10. Set the pressure simulator to 200 mmHg.
11. After allowing a few seconds for settling, check that the mean pressure reading is 200 mmHg ± 2 mmHg.
12. Remove the cable from the P1 input jack and verify that the message: P1 FAULT - TRANSDUCER NOT DETECTED appears.
13. Press any button to acknowledge the discontinuance of IBP monitoring.
14. Press MAIN MENU.

NIBP

1. Connect the adult cuff, manometer (or pressure meter) with bulb, and the monitor together with the Cuff Calibration Kit as shown in the figure below.



2. Wrap the adult cuff around a cylindrical object about the size of an adult's arm.
3. Press **SETUP > MORE > MORE > SERVICE > YES > NIBP TEST > NIBP CAL**.



The NIBP CAL mode holds pressure for 10 minutes. If performing steps 4 through 9 takes longer than 10 minutes, press NIBP CAL again.

4. Close the valve on the bulb and inflate the cuff to 250 mmHg as shown on the manometer.
5. Check that the readings (PR1 and PR2) on the monitor's display are 250 ± 3 mmHg (PR1) and 250 ± 15 mmHg (PR2), as show in the figure on page 2-13.

19:00:25				
NIBP TEST			BATTERY: 8.1 VOLTS	
	CNTS	mmHg	DAC	VALVE
PR1:	578	249.4	130	0
PR2:	338	259		
OSC:	1600			
LEAK:	10	mmHg	DIAG:	0
BLEED:		mmHg/min	PUMP:	secs
PUMP TEST	AUTO PMP	NIBP CAL	ZERO	PREV MENU

6. Manually reduce the pressure as indicated on the manometer to each of the levels shown in the following table, and check the displayed value of PR1 to be within the tolerance listed in the following table.

Pressure (mmHg)	Tolerance (mmHg)
270	± 4
250	± 3
200	± 2
100	± 2
50	± 2
20	± 2

7. Reduce the pressure to 0 mmHg and check that the displayed readings (PR1 and PR2) are 0 ± 2 mmHg.
8. Close the bulb valve.
9. Press CANCEL. (If there is no CANCEL button at this time, go to the next step.)
10. Disconnect the adult cuff from the test setup and connect the neonatal cuff #3 that is wrapped around a solid 3 cm diameter cylinder.
11. Press PUMP TEST.
12. Check that the pump inflates the cuff to approximately 280 mmHg.
13. After four minutes, check that the displayed leakage is less than 50 mmHg.



If the leakage exceeds this specification, first check all exterior hoses and fittings before diagnosing an internal air leak problem.

14. Press MAIN MENU.
15. Disconnect the cuff and Cuff Calibration Kit.

Temperature

1. Plug a 37.0° C YSI 400 series (two conductor) calibrated temperature probe simulator into the T1 jack on the Encore's left side panel.
2. Check that the T1 temperature is $37^{\circ} \pm 0.1^{\circ}$ C.
3. Repeat Steps 1 and 2 for T2.
4. Plug a 37° C YSI 700 series (three conductor) temperature probe simulator into the T1 jack.
5. Check for $37^{\circ} \pm 0.1^{\circ}$ C.
6. Repeat Steps 4 and 5 for T2.
7. Remove all connectors and turn the Encore off.

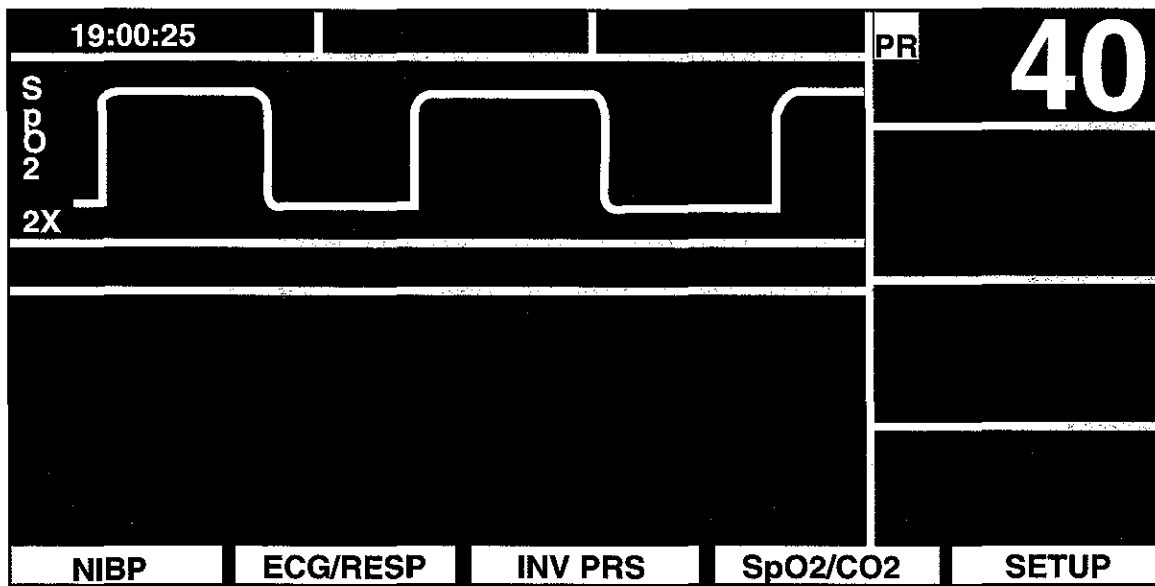
SpO₂ Checks

The following steps check the operation of the pulse oximetry option (SpO₂).

1. Disconnect all test cables from the patient channel connectors. (It is not necessary to disconnect the cuff hose.)
2. Connect a NELLCOR SpO₂ tester to the monitor.

The NELLCOR SpO₂ tester has no on/off switch: it automatically turns on with the monitor power.

3. Turn off all alarms by pressing the ALARMS SUSPEND/RESUME button.
4. Check that the displayed SpO₂ numeric is 81 ± 2 .
5. Check that the pulse rate is 40 ± 3 .
6. Check that the waveform is similar to the one shown on page 2-15.



7. Check that the speaker is sounding with every pulse indicated on the display.
8. Disconnect the SpO₂ tester from the Encore.
9. Check that an equipment alarm occurs.
10. Press any button to acknowledge the discontinuance of SpO₂ monitoring.
11. Press MAIN MENU.

Printer Tests

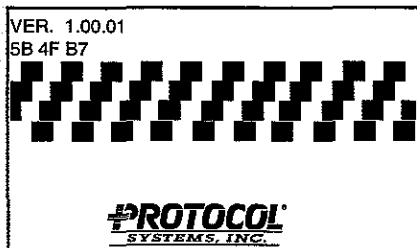
The following steps check the functionality of the printer.



Functional verification should be performed on the monitor before beginning the printer tests. The monitor must be functioning properly in order to perform printer tests.

1. Disconnect all cables from the monitor.
2. Turn the monitor OFF then ON.
3. Press SETUP > WAVE SEL > INSERV.
4. Press MAIN MENU.
5. Wait at least 8 seconds and then press the printer's SNAPSHOT button.
6. Check that the printer prints an approximately eight-inch strip of the simulated patient data. The paper should stop only after the entire waveform has been fed out of the printer.
7. Press the printer's START/STOP button. The printer should begin continuous printing.
8. Press the START/STOP button to stop printing.

9. Lay the Propaq Encore on its back.
10. Press the START/STOP button to start printing.
11. Completely open the paper door on the bottom of the Expansion Module.
12. Check that the printer stops printing, and that an equipment alarm and CHECK DOOR message appear on the monitor screen.
13. Cut or tear the printer paper in the printer mechanism from the roll, leaving the strip of paper in the printer mechanism.
14. Completely close the paper door.
15. Press the START/STOP button.
16. After the printer runs out of paper, check that an equipment alarm and PAPER OUT message appear on the monitor screen.
17. Open the printer door and reload the paper into the printer.
18. Close the paper door and set the monitor upright.
19. Simultaneously press the PRINT TRENDS and START/STOP buttons.
20. Check that a test printout similar to one shown in the figure below is printed.



CO₂ Verification Preparation

The CO₂ functional verification procedures require calculating the local barometric pressure and partial pressure of the test gas (in mmHg) to compare to Propaq Encore displayed values.

Local barometric pressure

The first step is to determine the local barometric pressure:

1. Determine local altitude above sea level.

For worldwide locations, obtain altitude from local geological maps (U.S.G.S. maps in the United States) or other local references on the maps. Refer to the table titled: Uncorrected Barometric Pressure as a Function of Altitude; use this table to determine the local uncorrected pressure (LUP).

2. Determine ATIS reported pressure (inches or millimeters of Hg).

For U.S. locations, consult local telephone directories to obtain the Automated Terminal Information Service (ATIS) number, typically listed under United States Government Offices, Department of Transportation, Federal Aviation Administration, and Air Traffic Control Towers.

Among various statistics reported is the "altimeter," which is given in four integers. The four digits represent the barometric pressure as referred to sea level, in units of inches of mercury, with an assumed decimal point occurring between the second and third numbers.

For worldwide locations, equivalent altimeter statistics, in millimeters of mercury, may be obtained from local agencies.



The difference in altitude between the calibration site and the ATIS site should not be greater than 30 m or 100 ft.

3. Determine local barometric pressure using LUP and ATIS. Apply the ATIS and LUP values to the following formula to calculate the local barometric pressure (mmHg):

$$\begin{aligned}\text{Local Barometric Pressure} = & \\ & 0.033421 \times \text{LUP} \times \text{ATIS (ATIS in inches of Hg)} \\ & 0.00131579 \times \text{LUP} \times \text{ATIS (ATIS in mm of Hg)}\end{aligned}$$

Example 1

Step 1. The altitude is 5000 *feet*. The local uncorrected pressure (LUP) is determined from the following table to be 632.35.

Step 2. The reported ATIS is 30.09 inches Hg. (Altimeter: three zero zero nine.)

Step 3. Multiply the LUP (632.35) times the ATIS (30.09) times 0.033421.

This gives the local barometric pressure of 635.92 mmHg.

Example 2

Step 1. The altitude is 1000 *meters*. The local uncorrected pressure (LUP) is determined from the following table to be 674.11.

Step 2. The reported ATIS is 764.29 mmHg.

Step 3. Multiply the LUP (674.11) times the ATIS (764.29) times 0.00131579.

This gives the local barometric pressure of 677.92 mmHg.

Partial pressure of test gas source

To determine the partial pressure of test gas source multiply the local barometric pressure (as determined in step 3 above) by the certified percentage ($\pm 0.01\%$ accuracy) of the test gas.

Example

The local barometric pressure (as calculated in Example 1 above) is 635.92 mmHg.

The certified CO₂ gas percentage is 5.00%.

Determine the CO₂ partial pressure by multiplying (635.92) \times (0.0500).

This gives the partial pressure of the CO₂ as 31.8 mmHg.

Local Uncorrected Barometric Pressure (LUP) as a Function of Altitude (Feet)

Altitude (Feet)	Pressure (mmHg)	Altitude (Feet)	Pressure (mmHg)	Altitude (Feet)	Pressure (mmHg)	Altitude (Feet)	Pressure (mmHg)
-2000	816.56	1000	732.93	4000	656.38	10000	522.65
-1900	813.66	1100	730.27	4200	651.52	10333	515.93
-1800	810.76	1200	727.62	4400	646.68	10667	509.26
-1700	807.87	1300	724.97	4600	641.88	11000	502.69
-1600	804.99	1400	722.33	4800	637.10	11333	496.18
-1500	802.11	1500	719.70	5000	632.35	11667	489.72
-1400	799.25	1600	717.07	5200	627.64	12000	483.34
-1300	796.39	1700	714.46	5400	622.95	12333	477.04
-1200	793.54	1800	711.85	5600	618.28	12667	470.78
-1100	790.70	1900	709.25	5800	613.65	13000	464.60
-1000	787.87	2000	706.65	6000	609.04	13333	458.50
-900	785.05	2100	704.07	6200	604.47	13667	452.44
-800	782.23	2200	701.49	6400	599.92	14000	446.46
-700	779.42	2300	698.92	6600	595.40	14333	440.55
-600	776.62	2400	696.36	6800	590.90	14667	434.68
-500	773.83	2500	693.80	7000	586.44	15000	428.89
-400	771.05	2600	691.26	7200	582.00	15333	423.17
-300	768.28	2700	688.72	7400	577.58	15667	417.49
-200	765.51	2800	686.18	7600	573.20	16000	411.89
-100	762.75	2900	683.66	7800	568.84	16333	406.35
0	760.00	3000	681.14	8000	564.51	16667	400.86
100	757.26	3100	678.63	8200	560.21	17000	395.44
200	754.52	3200	676.13	8400	555.93	17333	390.08
300	751.80	3300	673.64	8600	551.68	17667	384.76
400	749.08	3400	671.15	8800	547.45	18000	379.52
500	746.37	3500	668.67	9000	543.26	18333	374.34
600	743.67	3600	666.20	9200	539.08	18667	369.20
700	740.97	3700	663.73	9400	534.94	19000	364.13
800	738.28	3800	661.27	9600	530.82	19333	359.12
900	735.61	3900	658.82	9800	526.72	19667	354.15

Local Uncorrected Barometric Pressure (LUP) as a Function of Altitude (Feet)

Altitude (Feet)	Pressure (mmHg)	Altitude (Feet)	Pressure (mmHg)	Altitude (Feet)	Pressure (mmHg)	Altitude (Feet)	Pressure (mmHg)
1000	732.93	4000	656.38	10000	522.65	20000	349.24

Local Uncorrected Barometric Pressure (LUP) as a Function of Altitude (Meters)

Altitude (Meters)	Pressure (mmHg)	Altitude (Meters)	Pressure (mmHg)	Altitude (Meters)	Pressure (mmHg)	Altitude (Meters)	Pressure (mmHg)
-700	825.23	1000	674.11	2700	546.23	4400	438.74
-650	820.43	1050	670.03	2750	542.79	4450	435.86
-600	815.65	1100	665.98	2800	539.37	4500	432.99
-550	810.89	1150	661.94	2850	535.96	4550	430.14
-500	806.15	1200	657.92	2900	532.58	4600	427.31
-450	801.43	1250	653.92	2950	529.21	4650	424.49
-400	796.74	1300	649.94	3000	525.85	4700	421.69
-350	792.07	1350	645.98	3050	522.52	4750	418.90
-300	787.43	1400	642.04	3100	519.20	4800	416.12
-250	782.80	1450	638.12	3150	515.90	4850	413.36
-200	778.20	1500	634.22	3200	512.62	4900	410.62
-150	773.61	1550	630.34	3250	509.35	4950	407.89
-100	769.05	1600	626.48	3300	506.10	5000	405.18
-50	764.52	1650	622.63	3350	502.87	5050	402.48
0	760.00	1700	618.81	3400	499.65	5100	399.79
50	755.51	1750	615.00	3450	496.45	5150	397.12
100	751.03	1800	611.22	3500	493.27	5200	394.46
150	746.58	1850	607.45	3550	490.10	5250	391.82
200	742.15	1900	603.70	3600	486.95	5300	389.19
250	737.74	1950	599.97	3650	483.82	5350	386.58
300	733.35	2000	596.26	3700	480.70	5400	383.98
350	728.99	2050	592.57	3750	477.60	5450	381.39
400	724.64	2100	588.89	3800	474.51	5500	378.82
450	720.32	2150	585.24	3850	471.44	5550	376.27
500	716.01	2200	581.60	3900	468.39	5600	373.72
550	711.73	2250	577.98	3950	465.36	5650	371.20

Local Uncorrected Barometric Pressure (LUP) as a Function of Altitude (Meters)

Altitude (Meters)	Pressure (mmHg)	Altitude (Meters)	Pressure (mmHg)	Altitude (Meters)	Pressure (mmHg)	Altitude (Meters)	Pressure (mmHg)
600	707.47	2300	574.38	4000	462.33	5700	368.68
650	703.23	2350	570.80	4050	459.33	5750	366.18
700	699.01	2400	567.24	4100	456.34	5800	363.69
750	694.81	2450	563.69	4150	453.37	5850	361.22
800	690.63	2500	560.16	4200	450.41	5900	358.76
850	686.47	2550	556.65	4250	447.47	5950	356.31
900	682.33	2600	553.16	4300	444.54	6000	353.88
950	678.21	2650	549.68	4350	441.63	6050	351.46
1000	674.11	2700	546.23	4400	438.74	6100	349.05

CO₂ Verification Procedure

This procedure verifies the accuracy of the Encore's CO₂ measuring system. If verification test results exceed specification limits, calibration as instructed in Section 3 MAY or MAY NOT be required—there are multiple possible sources of errors in testing as listed in the table on page 2-22.

1. Connect a CO₂ sensor with airway adapter to the Encore CO₂ input connector.
2. Turn on the Encore. Press ALARM SUSPEND/RESUME to disable the alarms.
3. Press SETUP > MORE > MORE and then set the CO₂ measurement units to millimeters of mercury (mmHg).
4. Allow the monitor and sensor to warm up for at least 15 minutes.



Possible errors may be caused if the area has high background CO₂ levels or if CO₂ has been forced outside of the airway adapter and into the sensor itself. To reduce the background CO₂ level, the area should be well ventilated and, preferably, the technician should be the only person present. If CO₂ has been forced into the sensor, allow 24 to 48 hours for the CO₂ to dissipate.

5. After 15 minutes, check that the CO₂ reading (of ambient room air) on the Encore display is 1 mmHg, ± 1 mmHg.
6. Install a rubber stopper in each end of the sensor airway adapter. (Refer to the Required Equipment list on page 2-2.)
7. Connect the CO₂ gas source through the hole in the stopper on one end of the airway adapter. Leave the other end open.



Before performing the following steps, convert the percentage of the gas source to partial pressure (mmHg) according to the procedures in CO₂ Verification Preparation on page 2-16.

8. Introduce a flow of test CO₂ at a rate of 60 to 200 ml/min into the sensor airway adapter.
9. For test gas calculated partial pressure values of 30 mmHg or less, check the CO₂ reading on the Encore display to be within 3 mmHg.
10. For test gas calculated partial pressure values greater than 30 mmHg, check the CO₂ reading on the Encore display to be within $\pm 10\%$ of the partial pressure value.



If CO₂ test results are out of specification limits, check the table on page 2-22 for possible error sources. Always verify the test setup to minimize errors.

11. Disconnect the test gas source and other test equipment.
12. Disconnect the CO₂ sensor from the monitor.

13. Turn off the monitor.

14. Log the test date and results in your department log.



WARNING

Eliminate all the possibilities causing errors shown in the following table before performing the calibration procedure in Section 3. Recalibrating the altimeter as described in Section 3 without adequately eliminating all other possible faults may result in inaccurate EtCO₂ readings.

Possible Sources of CO₂ Verification Test Errors

Error	Specification	Correction
Incorrect/unknown calibration gas concentration	4 to 10% certified to within $\pm 0.01\%$	Verify gas supply. Gas must be between 4% and 10%. Once known, convert percentage to partial pressure (mmHg) as instructed earlier in this section.
Insufficient/excessive gas flow rate	Between 60 and 200 ml/min	Verify with flow meter.
Excessive back pressure in cuvette	Back pressure should not exceed 1 mmHg	Connect gases as instructed in verification test.
Air mixed with standard gas		Check integrity of test setup.
Gas temperature	Gas temperature entering airway adapter should be at room temperature	Store gas at room temperature.
Cuvette error	Results should not vary more than 0.5 mmHg due to cuvette tolerances	Use another cuvette (airway adapter).
Thermal equilibrium error	Sensor not warmed up	Allow sensor/system to operate for a 15 minute warm-up period.
High CO ₂ reading with sensor subject to room air only	CO ₂ forced outside of airway adapter into sensor. This is possible during demonstration if exhaled gases are blown through hands cupped around cuvette and exhaled gases are forced into sensor.	Contain exhaled breath through the inside of cuvette only. Do not allow gases to be forced outside of cuvette and into sensor housing. If CO ₂ has been forced into sensor allow 24 to 48 hours for the CO ₂ to dissipate.

Section 3

Calibration

Introduction

This section provides calibration procedures for the Propaq Encore. These procedures allow you to calibrate the Encore to Protocol factory specifications. Calibration procedures should be performed only by qualified service personnel.

Calibration procedures must be performed whenever a question arises as to the performance of the Encore, and as indicated in Section 1.

Functional verification procedures (see Section 2) verify that the monitor is performing to its specifications. A functional verification (Section 2) must follow the calibration.



The respiration, temperature, SpO₂ and printer circuitry do not require calibration. For service on these units, contact Protocol Systems, Inc. The CO₂ circuitry should be calibrated only if it fails the functional verification procedure of Section 2 AND you have eliminated all possible faults as listed in the table in the CO₂ functional verification procedure.

Equipment Needed

You will need the following equipment to calibrate the Propaq Encore monitor. Part numbers are given for equipment available from Protocol Systems, Inc.



All test equipment must be calibrated to function within parameters specified by the manufacturer, and be traceable to a national calibration standard.

Required Equipment

Description
Digital multimeter (DMM), 4 1/2 digit, Fluke 805A or equivalent
50 MHz triggered sweep oscilloscope, Tektronix 2225 or equivalent
Variable dc power supply, 0-28 V, 3A, VIZ WP-715A or equivalent
Patient simulator, Dynatech/Nevada 213A, 214A, 215A, or 217A with temperature and EGG cable/leads
0 to 300 mmHg mercury-column manometer with bulb
Invasive blood pressure (IBP) simulator, 5 μ V/mmHg, Fogg Systems BP48C, BP28, or MDE Datasim 6000, with IBP cables
Adult cuff (provided with monitor); cylindrical object about the size of an adult's arm
Protocol cuff calibration kit, Protocol part number 008-0012-XX
Propaq Encore ac power adapter (provided with monitor)
Resistor test loads (4.9 Ω and 4.65 Ω). Refer to Appendix A.
Dc supply cable, Protocol part number 008-0290-XX
Tools necessary to disassemble and reassemble the Encore monitor. (See Section 5 for a list of necessary tools and instructions on opening the monitor.)

Procedures

This section contains procedures for calibrating the Propaq Encore monitor:

- Recharger board
- Analog board
- Digital board



All calibration, service, and repair must be done at a static-protected work station. Failure to protect against damage due to static discharge can damage components in the Propaq Encore.

Setup

You must work at a static-protected work station. In order to calibrate the monitor you must open and then perform some disassembly to reach the necessary calibration points.



Refer to Section 5 for all disassembly and re-assembly procedures. Failure to follow disassembly procedures may result in damaged internal parts.

1. Before you begin disassembly, charge the battery pack for at least 8 hours to ensure it is fully charged.
2. Remove any options attached to the monitor. If either the SpO₂ or expansion module is attached to the monitor, remove it before starting the calibration. The calibration procedures in this section are for the three Encore monitor boards only.
3. Remove the battery pack.
4. Disconnect the ac power adapter from the monitor's right side panel power input connector.
5. Open the monitor.
6. Disconnect P1 (expansion connector cable) from the Analog board and open the front chassis approximately 90 degrees.



To disable the alarms while performing the calibration procedures, press **SETUP > ALL ALRM to remove the bell symbol from the display. In order to inhibit the Apnea alarm, turn off Respiration monitoring: press **ECG/RESP > MORE** and set **RESP** to **OFF**.**

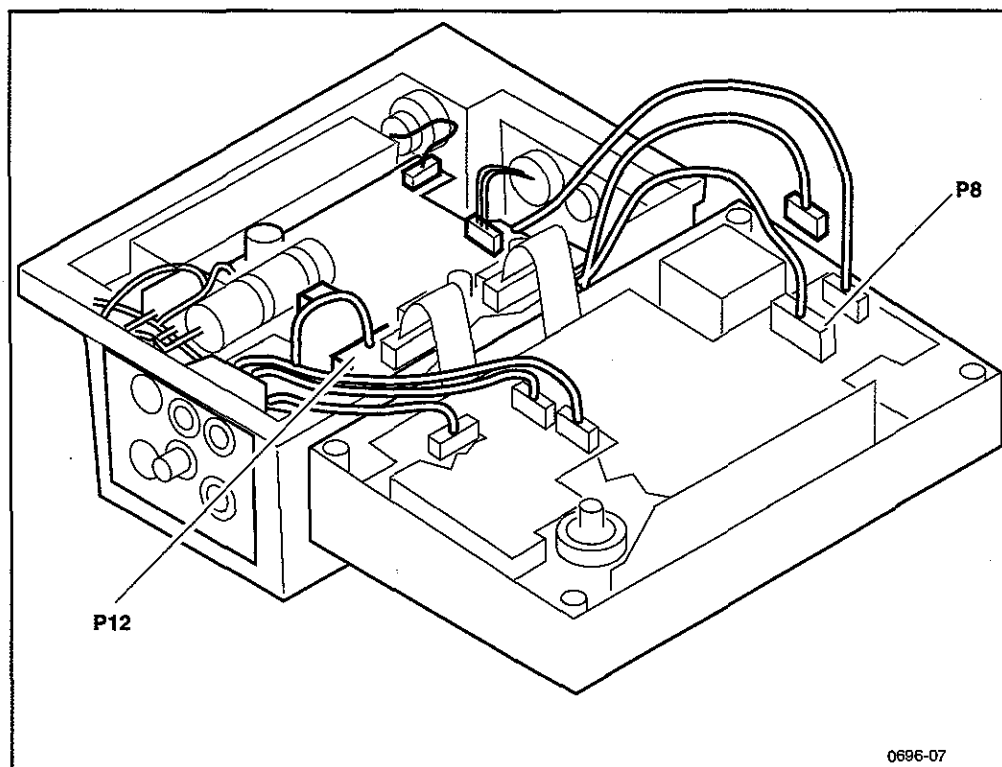
Recharger Supply Adjustments

**WARNING**

High voltages (approximately ± 200 V dc or 360 V ac) are present on the recharger board when the Encore is turned on. These voltages present a shock hazard if contacted during calibration.

Use non-conductive adjustment tools and keep fingers and conductive objects away from the Recharger board components when calibrating.

1. Verify that the Encore power switch is off.
2. Disconnect the battery connector from P12 on the recharger board (see figure below).
3. Disconnect P8 from the Digital board (see figure below).

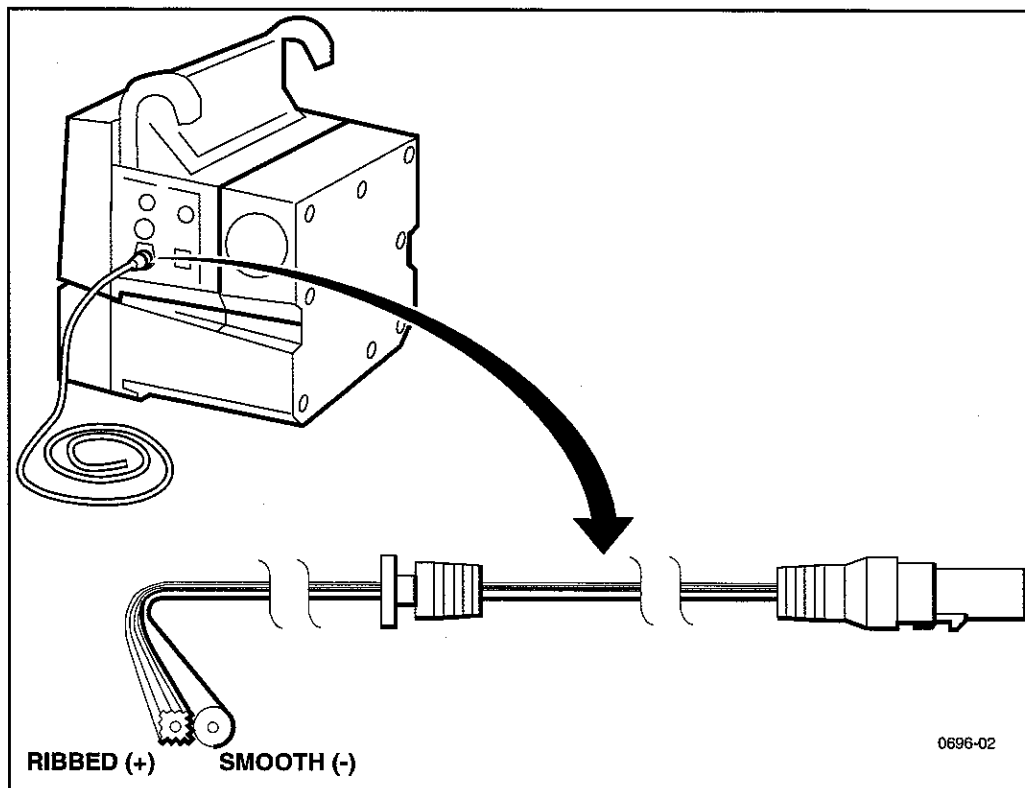


4. Connect the 4.9Ω test load (see Appendix A) to the battery connector (P12).
5. Set the power supply output to 15.0 V dc.



Adjustment of RP3 in step 12 below sets an overvoltage limit which, if misadjusted, can cause fuse F1 (on the right side panel) to open. If you suspect that RP3 has been misadjusted, turn it fully clockwise before connecting power to the dc input jack on the Propaq Encore.

6. Attach the dc power adapter cable to the variable dc power supply as shown figure below.



7. Connect the adapter cable to the monitor's dc input jack.
8. Verify that the input current from the variable dc power supply is less than 1.8 A and that the green LED on the Encore's right side panel is on.

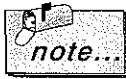


Refer to the figure on page 3-7 for adjustment and test point locations.

9. Connect the DMM positive lead to P12 pin 1 or 5.
10. Connect the DMM reference (negative) lead to non-isolated ground at TP2.
11. Adjust RP5 to $9.400\text{ V} \pm 0.010\text{ V dc}$.
12. Move the DMM positive lead to TP4.
13. Adjust RP3 to $2.393\text{ V} \pm 0.015\text{ V dc}$.

14. Move the positive lead back to P12 pin 1 or 5.
15. Vary the input voltage from 12 V to 28 V and check that the output voltage remains constant.
The battery load voltage must not vary more than 0.100 V dc.
16. Decrease the power supply voltage from 12 V to 7 V while checking the right side panel green LED. The LED should turn off between 7 and 12 V.
17. Disconnect the adapter cable from the Encore's right side panel.
18. Remove the 4.9 Ω test load and replace it with the 4.65 Ω test load.
19. Reconnect the adapter cable.
20. Adjust RP1 to 9.350 V \pm 0.010 V dc.
21. Remove the 4.65 Ω .
22. Reconnect the cable to P12.

Display Voltage Adjustments



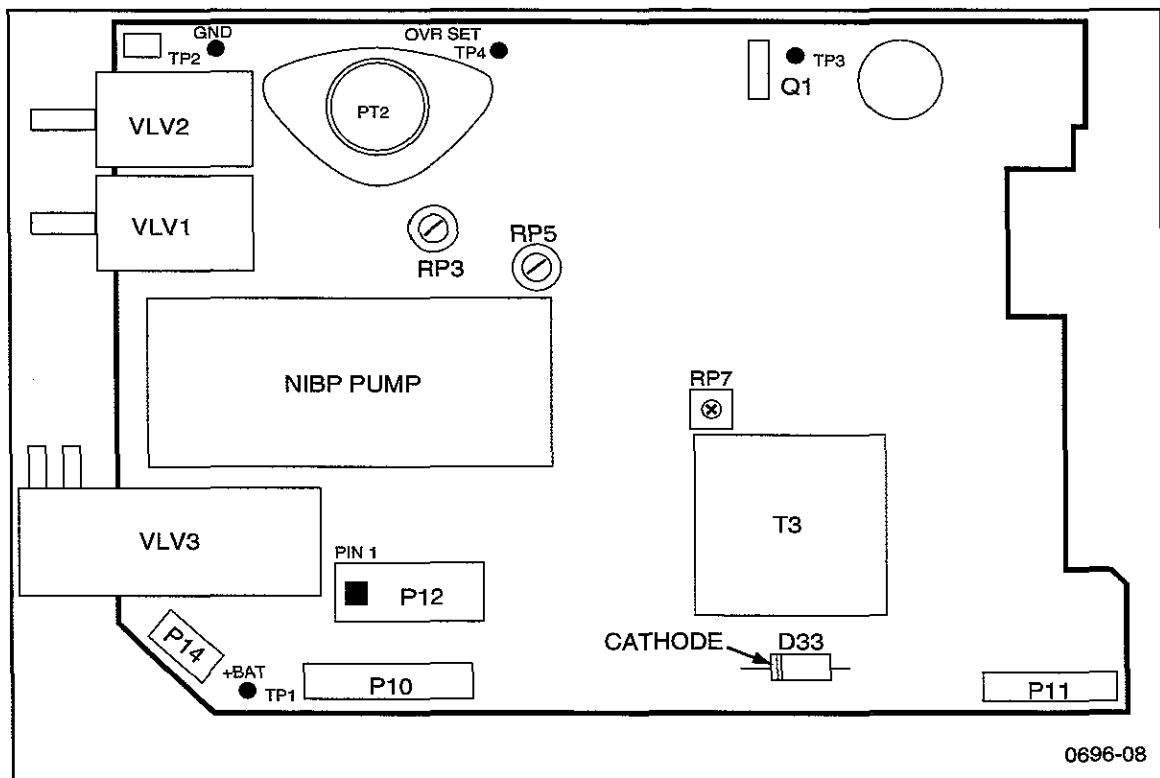
Do not adjust the display voltage unless the display has been changed and the lack of contrast between illuminated and non-illuminated pixels affects the display readability.

The following calibration adjusts the monitor display's high voltage supply which is located on the recharger board. The factory-set voltage is specific to the display and is indicated on the display module label.

If you know the voltage specified on the display label (i.e., are calibrating following an installation) use Procedure 1, below. If you do not know the voltage, use Procedure 2.

Procedure 1

1. Install the display according to the procedures described in Section 5, reconnect the cables between the front and rear chassis, and turn on the Encore. Note that when you turn the power on and off you initiate an equipment alert. Press any one of the five bottom buttons to reset.
2. Connect the DMM positive lead to the D33 cathode.



3. Connect the DMM reference lead to ground at TP2.
4. Adjust RP7 to the value indicated on the display module label.

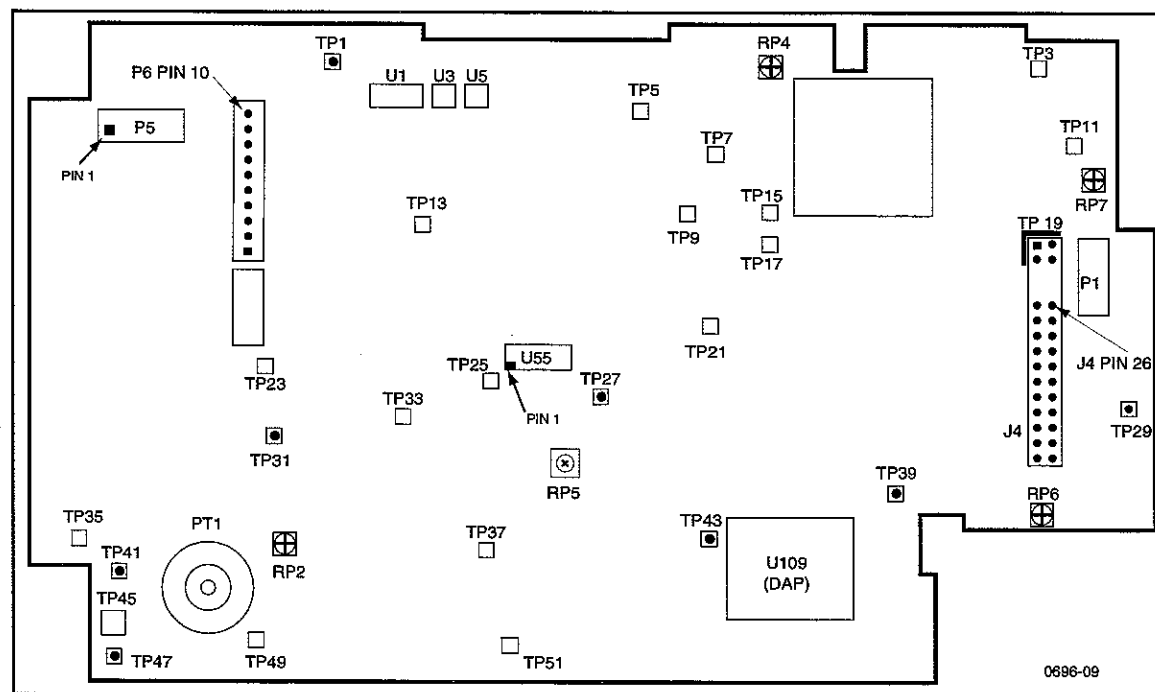
Procedure 2

1. Turn on the Encore and position the display for easy viewing.
2. Adjust RP7 clockwise until the background illuminates.
3. Find the brightest background area on the display and view this area through a paper tube approximately 2 inches in diameter (such as a paper towel or tissue paper tube) to shield the area from ambient light.
4. Adjust RP7 counter-clockwise until the viewed area fades to black.
5. Reposition the tube to view the brightest area (now dim) and simultaneously a lighted area (pixels on). Adjust RP7 clockwise until the background area just begins to illuminate.

Main Power Supply Adjustments

The following procedures assume you are continuing from the recharger board calibration. If not, refer to the setup procedures provided at the beginning of this section.

1. Turn off the monitor.
2. Remove the metal shield from the analog board. (Note the two different screw sizes; refer to Section 5 for instructions, if necessary.)



3. Connect the DMM reference lead to TP39.
4. Connect the DMM positive lead to TP29.
5. Turn on the monitor.

Press any of the lower five buttons to reset the Encore following equipment alerts.

6. Adjust RP7 to 5.000 V \pm 0.010 V dc.
7. Refer to the table below and check the dc supply voltages using the DMM.

Main Power Supply Voltage Checks

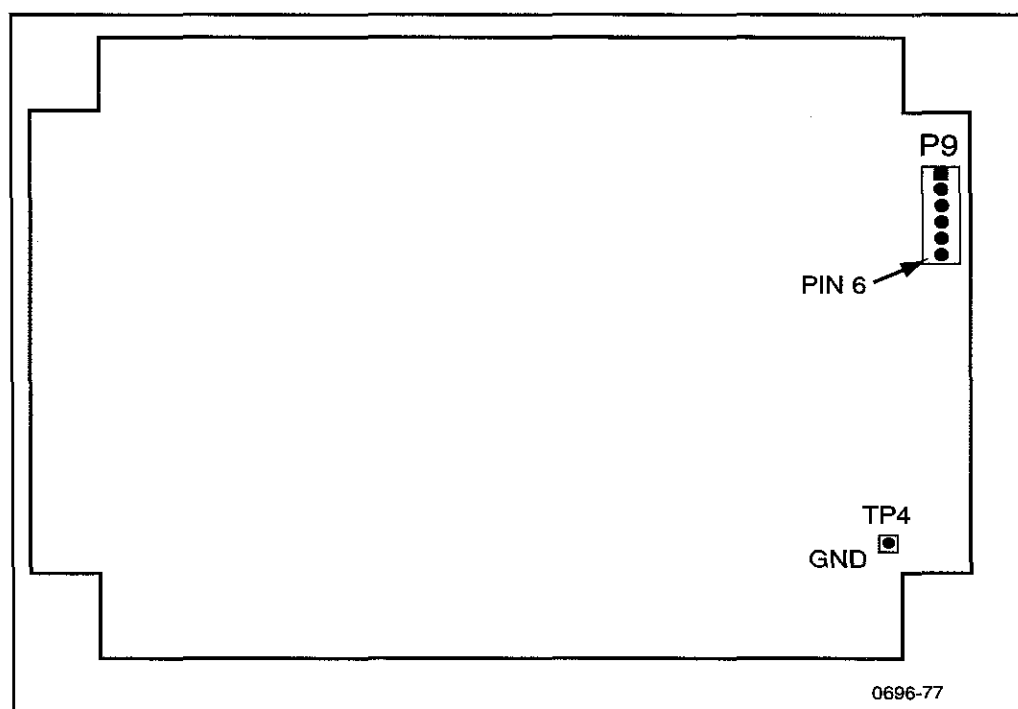
Supply Voltages	Ref. Lead	Pos. Lead	Voltage Limits
Non-isolated			
+15	TP39	TP3	+14.7 to +15.3
-15	TP39	TP11	-14.8 to -15.5
Isolated			
+VR	TP43 or TP1	TP9	+4.91 to +5.09
+VS	TP43 or TP1	TP5	+6.58 to +7.15
-VS	TP43 or TP1	TP21	-6.65 to -7.15
+VB	TP43 or TP1	TP13	+5.40 to +6.10
+5.6	TP43 or TP1	TP33	+5.55 to +5.70
IBP shield	TP43 or TP1	P6, Pin 10	+2.47 to +2.53
C.L.P. detector ^a	TP43 or TP1	U5, Pin 1	0.00 to +0.25
NIBP Pressure Offset	TP43 or TP1	TP31	+2.40 to +2.60
OSC baseline	TP43 or TP1	TP47	-0.95 to -1.25
+VA	TP43 or TP1	TP7	(+VR + 0.1V) to (+VR + 0.2V)
-VA	TP43 or TP1	TP15	(+VR + 0.2V) to (-VR + 0.35V)
+2.5	TP43 or TP1	TP17	+2.48 to +2.52V

- a. Make sure the ECG input connector (P5) is disconnected from the analog board for this measurement. Reconnect when done.

8. Disconnect the DMM leads.

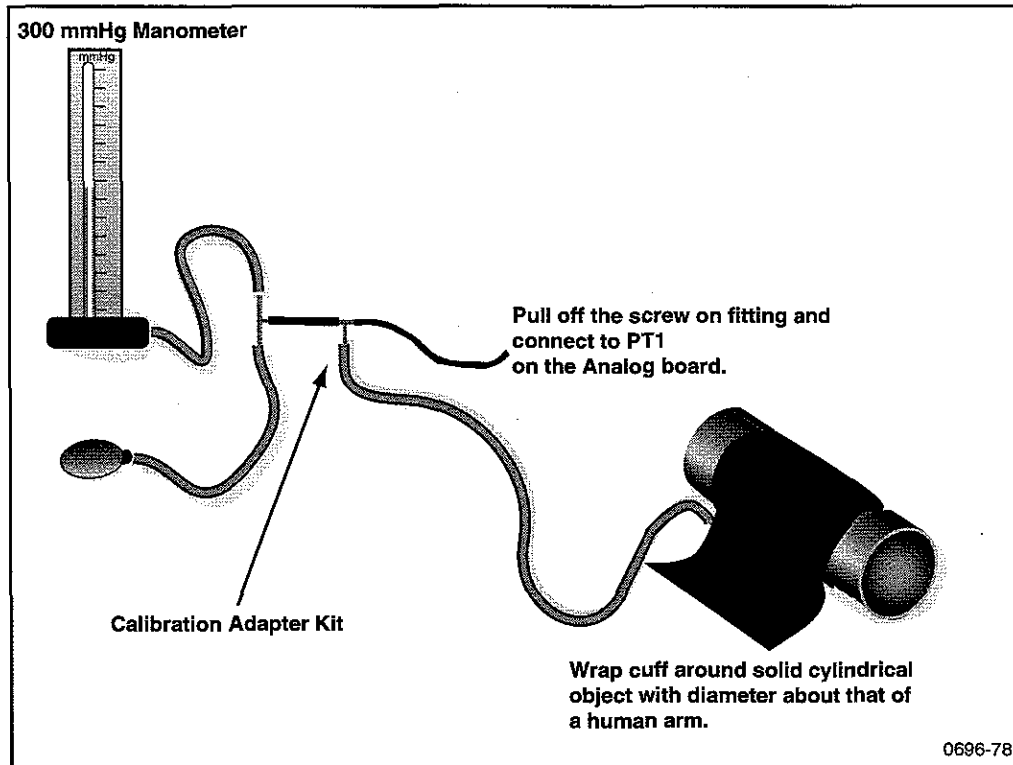
Calibrating Realtime ECG Out

1. Connect the 5-lead ECG cable to the monitor and the simulator.
2. Set the simulator to 80 bpm, normal sinus rhythm.
3. Set the monitor to Lead II.
4. Connect the dc-coupled oscilloscope probe to the **Digital board** at P9 pin 6 (see figure below), and the reference probe to TP4 on the **Digital board**.
5. On the Analog board, carefully short together U55 pins 1 and 2.
6. Adjust RP6 on the Analog board to 0 V dc ± 0.1 V.
7. Remove the short and check for an ECG signal displayed on the oscilloscope of 1.0 V ± 0.1 V baseline to peak of the R-wave.
8. Disconnect the ECG cable from the monitor.



Non-Invasive Blood Pressure Calibration

1. Connect the cuff, manometer with bulb, and the Encore together with the cuff calibration kit, as shown.



2. Connect the NIBP test setup to the pressure transducer at PT1.
3. Wrap the adult cuff around a cylindrical object about the size of an adult's arm.
4. Press **SETUP > MORE > MORE > SERVICE > YES > NIBP TEST > NIBP CAL**. Use the bulb to inflate the system pressure to 250 mmHg, as read on the manometer.



If testing takes more than 10 minutes, NIBP CAL will cancel. Press NIBP CAL again and resume testing.

5. Watching the value of PR1 on the Encore monitor screen, adjust RP2 until the service screen reading matches the manometer.

19:00:25					
NIBP TEST			BATTERY: 8.1 VOLTS		
	CNTS	mmHg	DAC	VALVE	
PR1:	578	249.4	130	0	
PR2:	54	0			
OSC:	1600				
LEAK:		mmHg	DIAG:	0	
BLEED:		mmHg/min	PUMP:	secs	
PUMP TEST	AUTO PMP	NIBP CAL	ZERO	PREV MENU	

6. Manually change the system pressure to check linearity tolerances at the following levels:

Pressure (mmHg)	Tolerance (mmHg)
270	±4
250	±3
200	±2
100	±2
50	±2
20	±2

7. Deflate the pressure to 0 mmHg.
8. Disconnect the tube from the transducer.
9. Set the oscilloscope to ac-coupled, bandwidth limited.
10. Connect the oscilloscope probe to TP47 on the Analog board.
11. Connect the oscilloscope reference lead to TP43 or TP1 on the Analog board.
12. Check for ≤ 15 mV peak-to-peak noise.



Measure the low frequency noise (bounce) only. Make the peak-to-peak measurement from the center-to-center of the trace to disregard the "fuzzy" high frequency noise.

13. Disconnect all patient inputs to the Encore's left side panel.

EMI Null Adjustment

1. Touch the oscilloscope probe to TP45 on the Analog board (square metal pad).
2. Disconnect the oscilloscope reference lead.
3. Set the oscilloscope vertical sensitivity and horizontal timing to observe the ac mains noise component.
4. Adjust RP4 to null the higher frequency (≈ 100 kHz) noise over-riding the ac mains component.
5. Move the oscilloscope probe to TP19 (upside down "L" shaped pad above J4). See figure on page 3-8.
6. Adjust RP1 on the Digital board (accessed through slot in Analog board) to null higher frequency (≈ 100 kHz) noise, over-riding the ac mains component.
7. Disconnect the scope probe.

Invasive Blood Pressure

Skip this part of the calibration procedure if your Encore does not support IBP measurements.



Many blood pressure simulators are not intended for use as calibration standards. Use only recommended simulators for calibrating the Encore.

1. Connect the IBP simulator to P1 on the Encore left side panel.
2. Set the patient simulator to 0 mmHg.
3. Press ZERO P1 to zero the channel.
4. Set the patient simulator to 200 mmHg.
5. Adjust RP5 for a numeric reading of 200 mmHg on the Encore monitor screen.



If your Propaq Encore does not include a second pressure channel, skip Steps 6 - 10.

6. Move the IBP cable to the P2 connector.
7. Set the simulator to 0 mmHg.
8. Press ZERO P2 to zero the channel.
9. Set the simulator to 200 mmHg.
10. Check that P2 displays 200 mmHg ± 2 mmHg.
11. Disconnect all patient cables from the left side panel.

12. Reinstall the Analog board shield and torque it according to the procedure in Section 5.

**WARNING**

You must perform a functional verification after calibrating the Propaq Encore to ensure all monitoring functions and safety features operate normally.



Because the battery was disconnected in the calibration procedures, you will need to reset the time, date and all saved settings. See the *Propaq Encore User's Guide* for information on resetting these parameters.

Section 4

Troubleshooting

Introduction

This section provides information that can be helpful in troubleshooting the Propaq Encore monitor.

Screen Messages

Messages may appear on the display to inform the operator of some condition requiring operator or service attention. Messages that indicate that the Propaq Encore may need servicing are listed below. For information about other messages, refer to the *Propaq Encore Reference Guide*.

PROGRAM FAULT: SETTINGS LOST, TIME/DAY RESET. If this message appears when the Propaq Encore is first turned on, it generally indicates a drained battery. The monitor can be used, but the time and date and all other settings will return to factory defaults each time the monitor is turned off. Replace the battery as soon as possible and reprogram the time, date, and other settings.

CUFF FAULT: NIBP DISABLED, SERVICE REQUIRED. A single fault was encountered in the NIBP system. Perform a functional check and calibration or repair as needed.

CALIBRATION ERROR, TEMP DISABLED. This message appears when the Propaq Encore has detected that temperature circuitry is out of calibration. The temperature channel is disabled until the Propaq Encore is repaired. There are no temperature channel adjustments; the temperature channel uses a regulated power supply as a reference. Check all power supply values (Section 3). The Analog board may need to be replaced.

SENSOR FAILURE, CALIBRATION ERROR. A very negative number has been generated by the CO₂ algorithm. This may be caused by a sensor that is defective or out of calibration. The CO₂ channel is disabled until the sensor cable is disconnected. Contact Protocol Technical Support.

SENSOR FAILURE, E2PROM. A failure in the sensor E2PROM is detected (typically a checksum error). The CO₂ channel is disabled until the sensor cable is disconnected. Contact Protocol Technical Support.

SENSOR FAILURE, HEATER. A failure in the sensor temperature control hardware is detected (typically sensor error, but may be CO₂ circuitry malfunction). The channel is disabled until disconnect. Contact Protocol Technical Support.

SENSOR FAILURE, MOTOR DRIVE. CO₂ sensor motor drive hardware has failed. The channel is disabled until disconnect. Contact Protocol Technical Support.

Non-Recoverable Error Codes

Non-recoverable errors are detected by software and indicate the Propaq Encore is no longer able to function properly and must be returned to Protocol for service. Contact Protocol Technical Support.

When a non-recoverable error is found, the software attempts to put the error message and its number on the Propaq Encore display. All monitoring functions are locked out. Non-recoverable errors are therefore distinct from equipment alerts, which permit reduced monitoring capability.

Non-recoverable errors are indicated in the following format:

x - yyy -zzzz

where:

- x = 0 indicates a problem found by the Display Control Processor (DCP).
- x = 1 indicates a problem found by the Data Acquisition Processor (DAP).
- x = 2 indicates a problem found by the Printer Control Processor (PCP) on the Printer Main board.
- x = 3 indicates a problem found by the SpO₂ Control Processor (SCP) on the SCP board.
- x = 5 indicates a problem found by the Main Stream Processor (MSP) on the MSP (CO₂) board.

yyy-zzzz indicate specific types of problems. Contact Protocol Systems Technical Support for more details.

Battery Capacity Check

Several variables affect monitor operating time on battery:

- active options
- frequency of NIBP measurements
- frequency and length of printouts
- ambient temperature,
- battery age and condition
- displayed information.

Refer to the *Propaq Encore Reference Guide* for battery care information and expected operating times. If the monitor fails to operate on battery for an extended period of time, follow the procedure below to check the capacity of the Encore's lead acid battery. Lead acid batteries have a very limited shelf life; you must test the battery if the Encore has been stored for two or more months without the ac power adapter plugged in.



A new battery should pass the following test. The run time of older batteries will decrease proportionally with age. Replacement is recommended when the run time becomes insufficient for the monitor's intended application.

1. Use the ac power adapter and charge the monitor for at least 8 hours with the monitor turned off (12 hours if a printer or pulse oximeter is attached).
2. Disconnect the cuff and all cables from the monitor.
3. Turn off all printing (if a printer is attached).
4. Disconnect the power adapter.
5. Turn on the monitor.
6. Run the monitor for 4 hours.
7. Check that the monitor did not automatically turn off.
8. Press MAIN MENU.
9. Use the ac power adapter and charge the monitor for at least 8 hours with the monitor turned off. (Charge at least 12 hours if a printer or pulse oximeter is attached.)

Section 5

Repair Procedures

Introduction

This section provides instructions for removing and replacing serviceable modules in the:

- Propaq Encore monitor
- expansion module (which may include any or all of the following: printer, SpO₂, CO₂)
- SpO₂ module

Instructions on how to remove the battery pack are followed by instructions on how to disassemble the monitor, the expansion module, the printer, the SpO₂ module, and the CO₂ module.



In general, re-assembly procedures are the opposite of the disassembly procedures. If there are items to note during re-assembly, they are described after the disassembly section.



WARNING

Whenever the monitor is opened for calibration or repair, a risk (leakage) current safety check and a hi-pot test must be performed followed by a complete functional verification. These procedures are located in Section 2.

Propaq Encore Software

Software to run the Propaq Encore monitor exists in PROMs (Programmable Read-Only Memory). The following PROMs are field replaceable:

- MSP PROM on the CO₂ circuit board in the Expansion module
- SCP PROM on the SCP board in the SpO₂ module
- PCP PROM on the Printer Main board attached to the printer in the Expansion module

When you remove one of these boards for replacement, you should remove the PROM from the board and store it in an anti-static plastic bag until you receive the replacement board. Keeping the PROM allows you to install it in the new board and ensures the replacement board will be compatible with the rest of your Encore system software.



The Analog and Digital boards cannot be replaced in the field because of special programming that must be done at the factory or by an authorized warranty service center. For Analog and Digital board service, call Protocol Technical Support.

**WARNING****STATIC DISCHARGE WARNING**

All calibration, service, and repair must be done at a static-protected work station. Failure to protect against damage due to static discharge may reduce monitor operation life and increase repairs. Place the monitor in an anti-static area before servicing the monitor.

Required Tools

The following tools are required to disassemble and reassemble the Propaq Encore components.

Required Tools

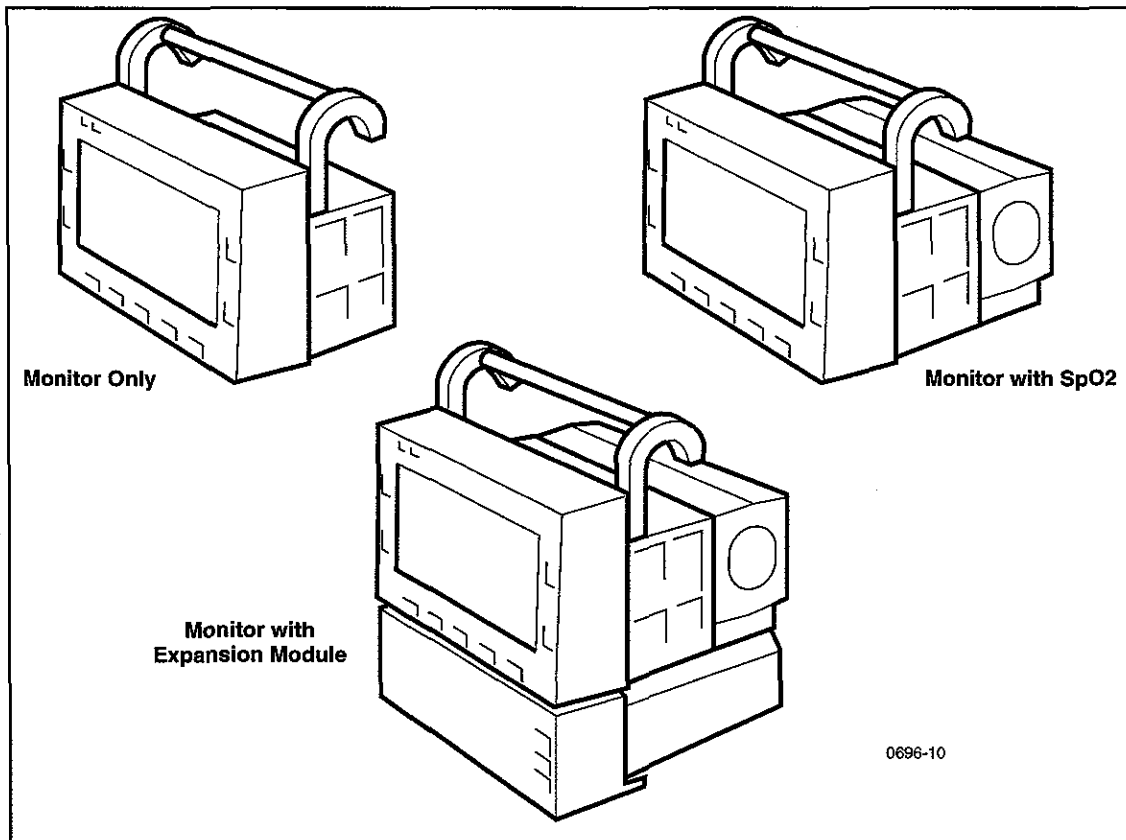
Description
Phillips screwdrivers, #1 and #2
Flat blade screwdriver
Adjustable torque screwdriver (3.8 in-lb to 7.35 in-lb.; .43 N-m to .83 N-m), with Phillips and 3/16" nut driver heads
Tweezers to help with screw removal and replacement
Static-free mat and wrist band equipment
Wire cutter to remove tie wraps
Tie wrap tool
De-ionized (neutralized), filtered, dry, non-combustible gas under pressure for removing any dust or debris from the monitor's interior.
Pliers
PROM Remove Tool: Amp Part Number 821903-1



It is recommended you use de-ionized gas for removing dust and debris prior to reassembly of monitor components. Commercial devices are available to neutralize compressed gases.

Propaq Encore Options

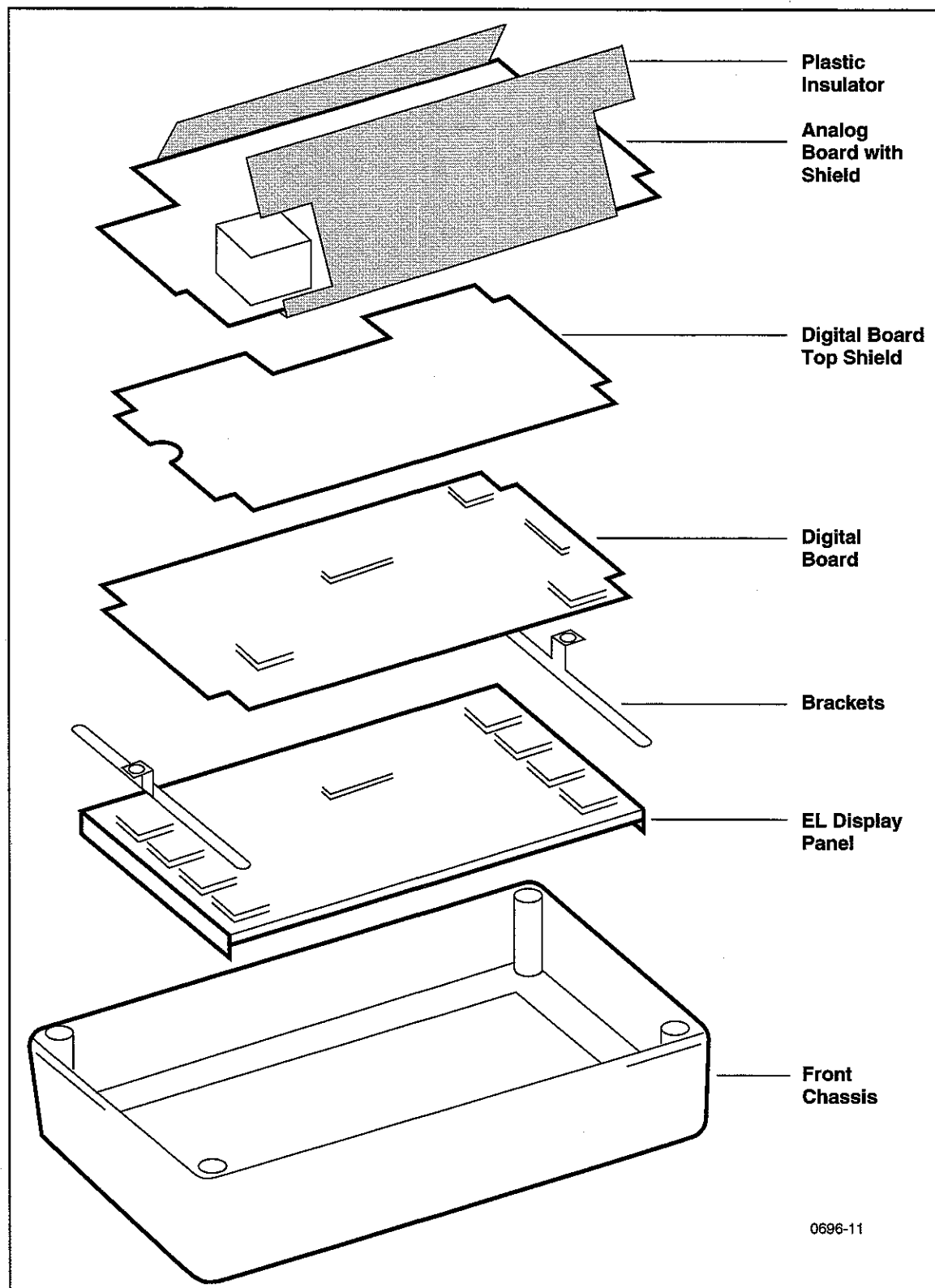
Your Propaq Encore may contain an option module that attaches to the monitor. You must remove the option module before you can disassemble the monitor. For instructions on how to remove the expansion module, refer to **Replacing the Battery Pack** on page 5-7. For instructions on how to remove the SpO₂ module, refer to **Removing the Dual Battery in SpO₂ Module** on page 5-11.



Field Replaceable Units in the Monitor

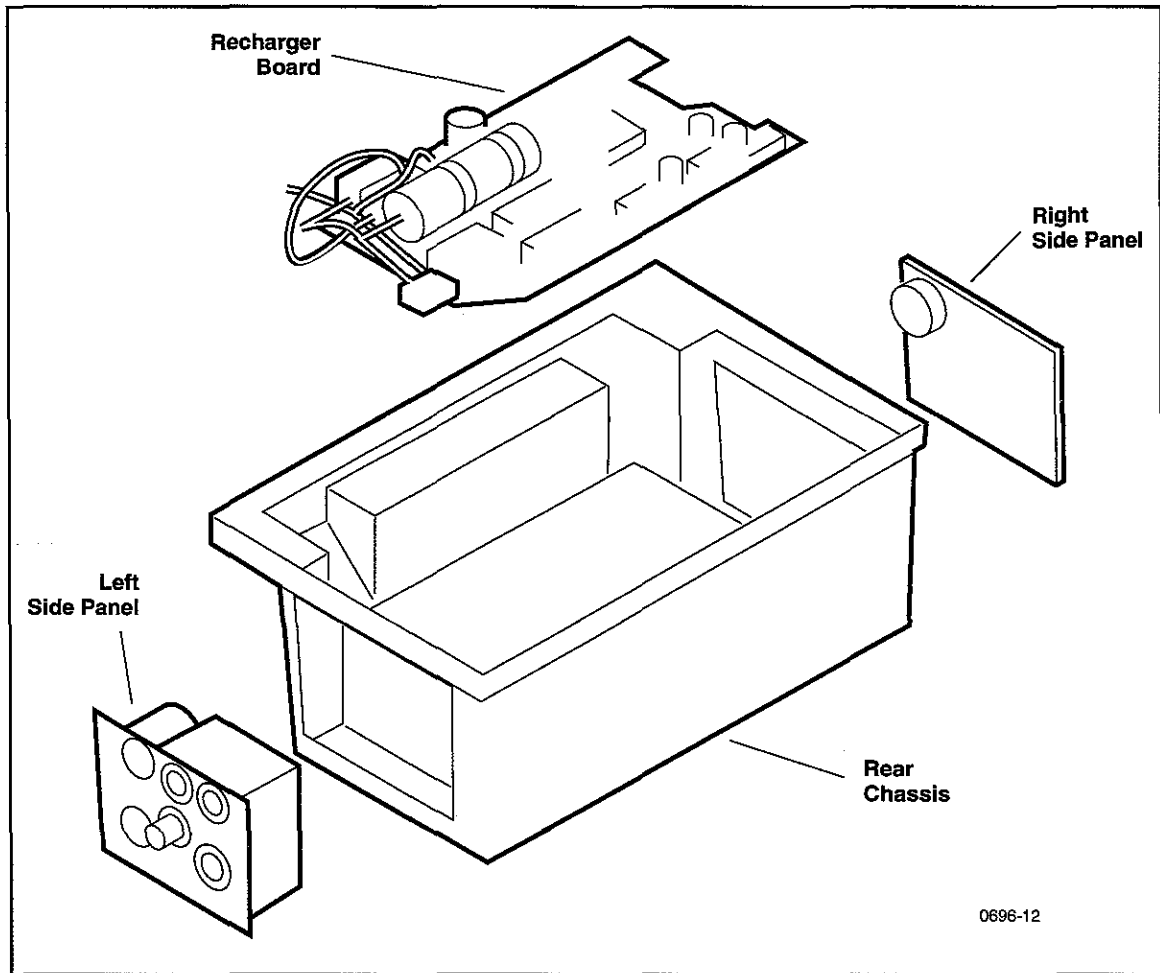
The front chassis of the monitor contains the following components:

- insulator
- Analog board with metal shield and insulator
- Digital board with shields
- EL display unit
- front chassis with display filter and gasket



The rear chassis contains the following components:

- Recharger board
- side panels (right and left)
- NIBP pump
- NIBP tubing
- NIBP valves

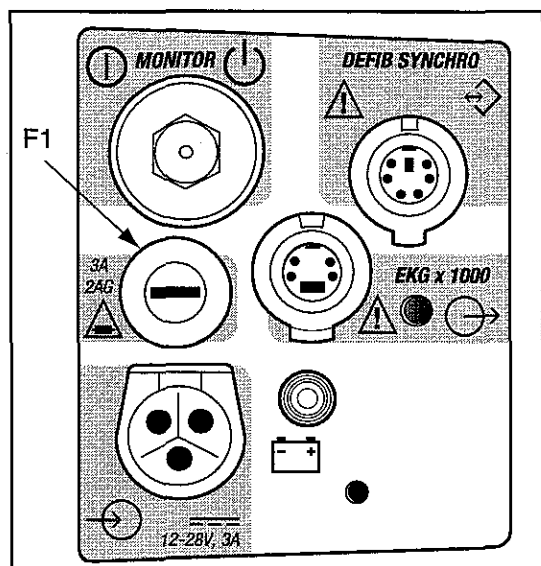


Replacing the Power Input Fuse

The F1 fuse protects the Recharger board circuitry against excessive current at the dc input connector. You do not need to disassemble the Propaq Encore to replace this fuse.

Check fuse F1 if the ac power adapter is functioning properly and the following two conditions exist:

- the green LED charging indicator on the monitor's right side panel does not illuminate
- the monitor battery does not charge



To remove the fuse, use a flat blade screwdriver to turn the fuse cover and release the fuse.



Replace the fuse only with one of the same rating and size. See Section 7 for Protocol part numbers.

Replacing the Battery Pack

**WARNING**

Although the battery pack includes a fuse to prevent against personal and equipment damage, the sealed lead-acid battery pack is capable of quickly delivering dangerously high currents if improperly handled, misused, or abused. These current levels may burn skin or damage the Propaq Encore. Use extreme caution when handling the battery pack.

The battery fuse is not replaceable. If the battery is shorted, the entire pack must be replaced. Do not try to service the battery fuses.

Insert a new battery pack into the Propaq Encore when the current battery no longer holds an adequate charge. Verify the battery charges to capacity according to the **Battery Capacity Test** in Section 4.

The battery maintains programmed defaults and time of day. Without the battery, the values for these items return to the factory settings. If the power up error message **TIME/DATE SETTINGS LOST** is displayed, reprogram the time and day and monitoring default parameters according to the procedures described in the *Propaq Encore Reference Guide*.

**WARNING**

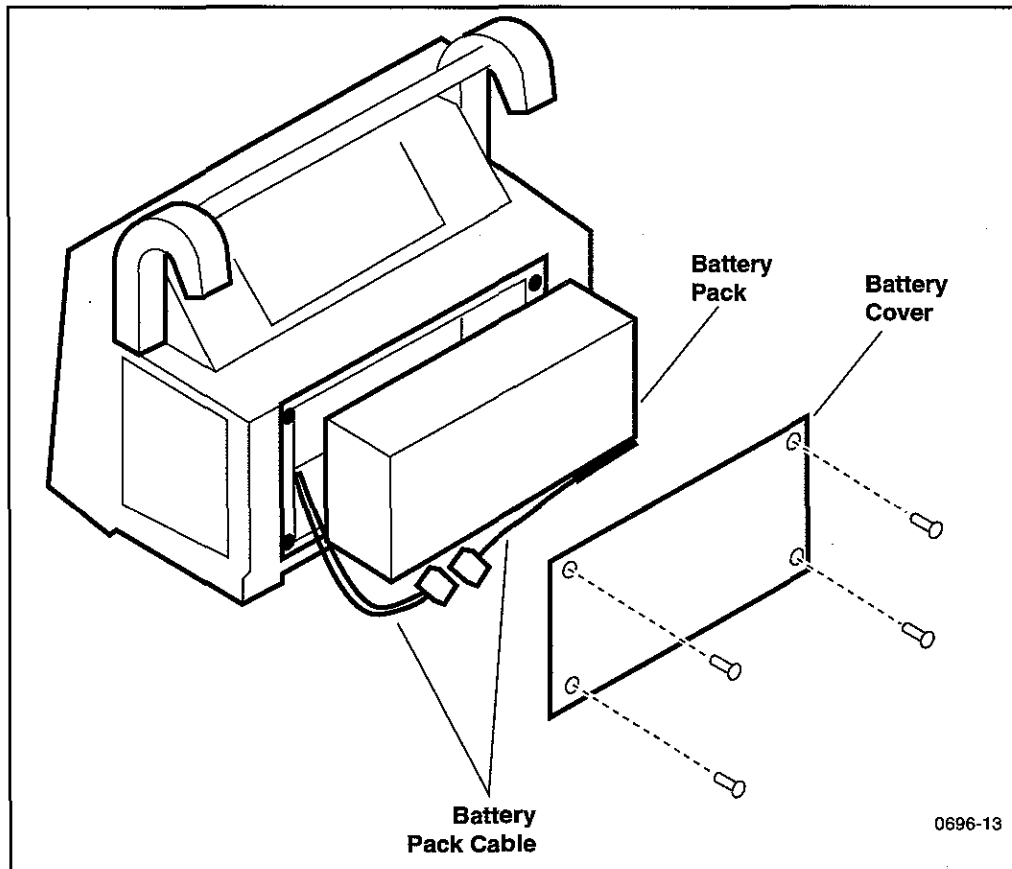
Do not pinch the battery wires when inserting the battery pack into the Propaq Encore. Monitor failure or fire could occur if wires get pinched.

You must remove the battery pack before opening the monitor case and replacing components. A Propaq Encore without options contains a single battery pack. An Encore with an option package uses a dual battery package.

Removing the Single Battery Pack

The following steps describe how to remove the battery pack from the monitor:

1. Using a flat blade screwdriver, unscrew the four screws securing the battery pack cover as shown below.



2. Disconnect the battery pack cable from the battery pack.
3. Remove the battery pack from the monitor.
4. Store the battery in a safe place while disassembling the monitor.

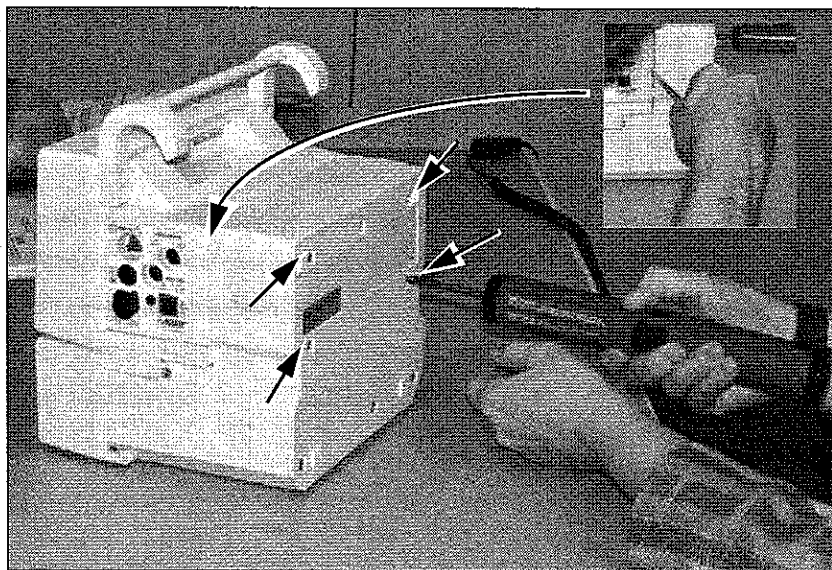
Removing the Dual Battery in Expansion Module

The expansion module uses a dual battery pack. The following instructions describe how to remove the dual battery.

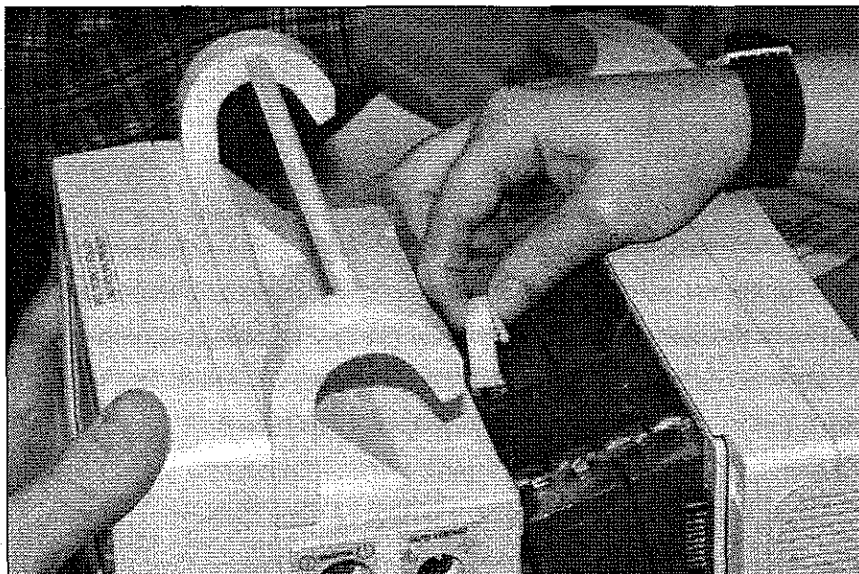


Four screws secure the expansion module to the monitor. Four additional screws secure the rear panel to the expansion module chassis; do not remove these additional screws.

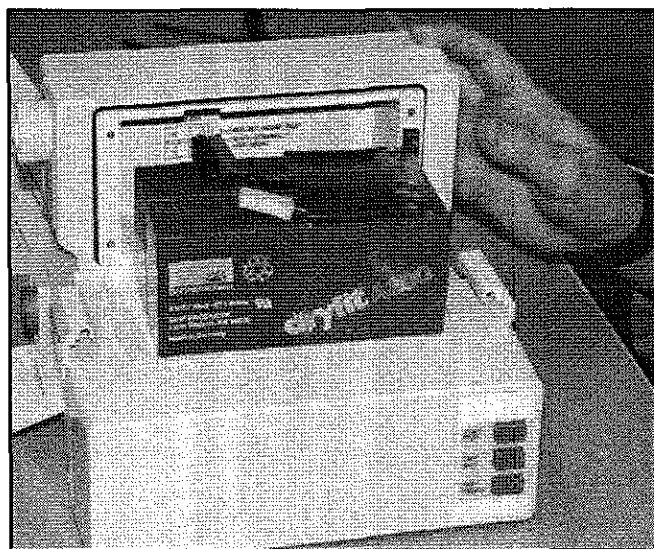
1. Using a Phillips screwdriver, remove the four screws securing the expansion module to the monitor (see figure below).



2. Use the flat blade screwdriver to gently loosen the expansion module from the monitor (see inset above).
3. Slide the monitor forward until you can disconnect the battery pack cable from the monitor's power cable (see figure on page 5-10). The battery pack should remain in the expansion module chassis.



4. Continue to slide the monitor forward until it can be completely separated from the expansion module.
5. Slide the dual battery pack forward out of the expansion module until the battery connector can be reached.
6. Disconnect the battery connector from the expansion module (see figure below).



7. Remove the dual battery pack from the expansion module.
8. Store the battery in a safe place while disassembling the monitor and expansion module.

Removing the Dual Battery in SpO₂ Module

The steps for removing the battery pack from the SpO₂ module are identical to those in removing the battery from the expansion module, except you remove all screws on the rear panel. The monitor is secured to the SpO₂ module with four screws; each screw has two washers.

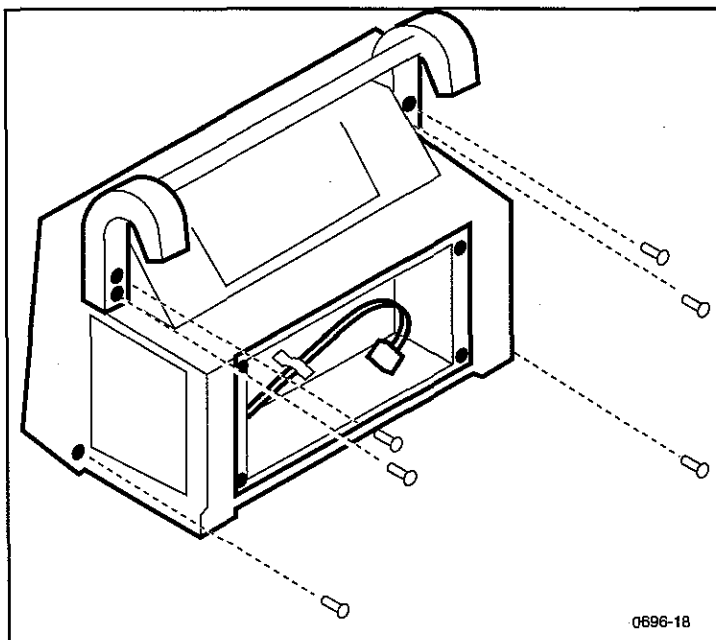
1. Using a Phillips screwdriver, remove the four screws from the SpO₂ module rear panel.
2. Slide the monitor forward until you can disconnect the battery pack cable from the monitor's power cable.
3. Slide the monitor forward until it can be completely separated from the SpO₂ module.
4. Remove the dual battery pack.
5. Store the battery in a safe place while disassembling the monitor and SpO₂ module.

When attaching the SpO₂ module, verify that the continuous O-ring gasket is in place.

Opening the Monitor

Follow these steps to open the monitor casing and gain access to the three removable monitor boards.

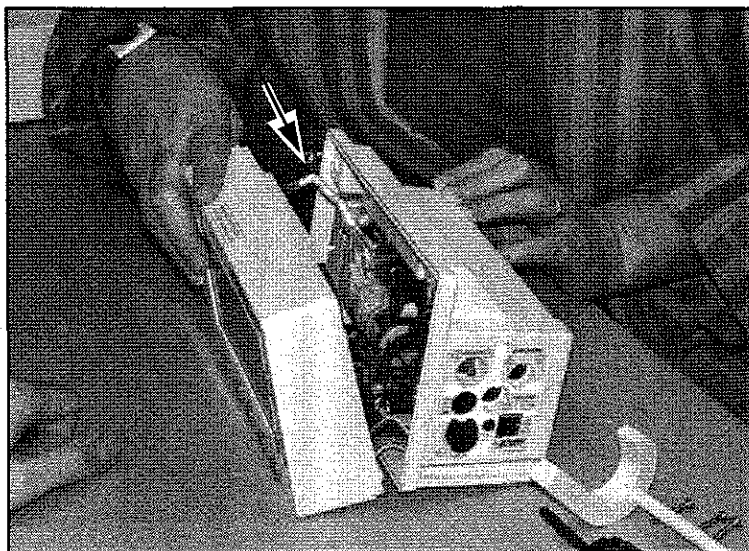
1. Remove the battery pack according to the procedures on page 5-7.
2. Using a Phillips screwdriver, remove the six screws securing the handle and monitor casing.



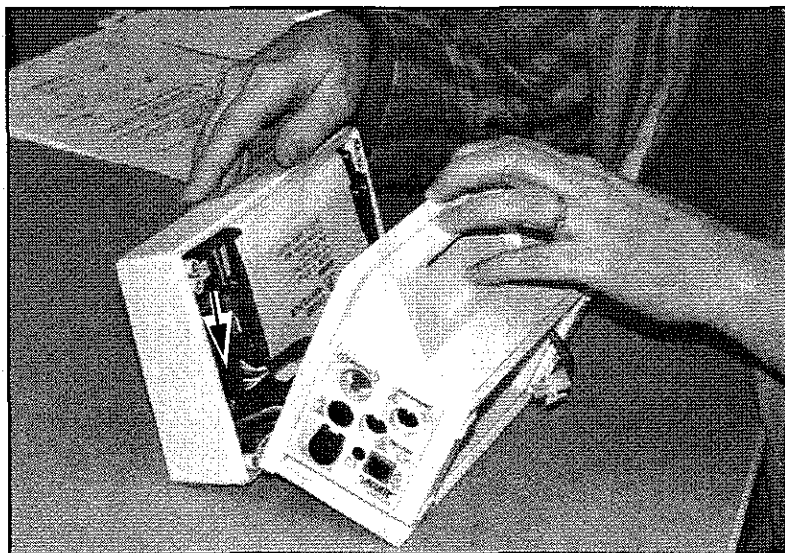


Before opening the casing more than one inch in the next step, disconnect the tube from the pressure transducer at the joint. Failure to disconnect the tubing may cause damage to the transducer or tubing.

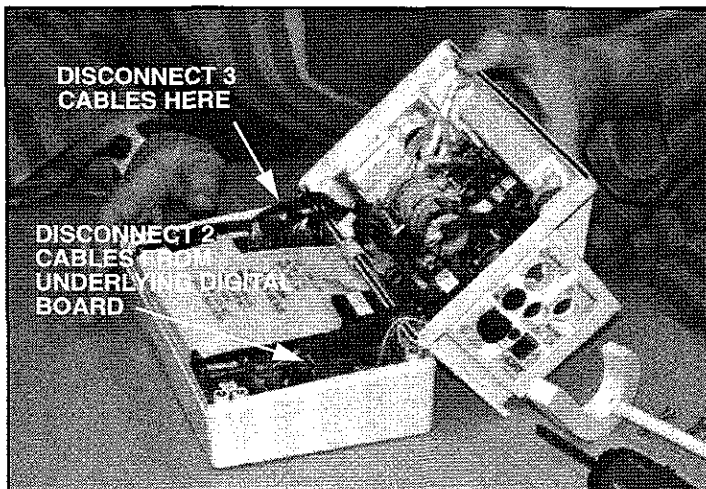
3. Slightly spread the casing open at the top until you can disconnect the pressure transducer tube indicated in the figure below.



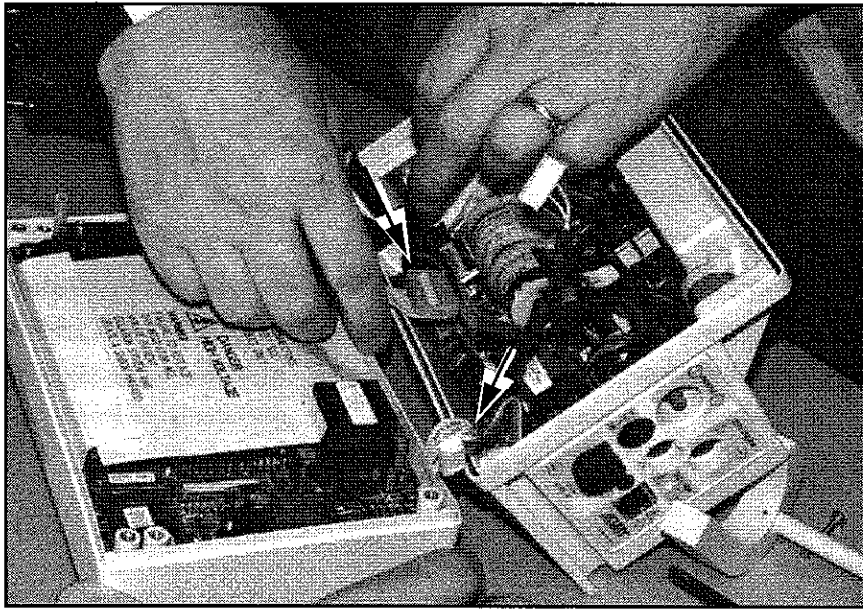
4. Spread the casing open to an angle of 45 degrees.
5. Detach the expansion connector cable (to P1) from the front chassis of the monitor as indicated in the figure below.



6. Spread the casing open to an angle of about 80 degrees.
7. Detach the following cables from the front chassis (indicated in figure below):
 - Cable to P5 on the Analog board, from the left side panel ECG connector on the rear chassis.
 - Cable to P6 on the Analog board, from the left side panel IPB connector on the rear chassis.
 - Cable to P7 on the Analog board, from the left side panel temperature jack on the rear chassis.
 - Cable to P8 on the lower (Digital) board, from the right side panel on the rear chassis.
 - Cable to P9 on the Digital board, from the right side panel on the rear chassis.



8. Detach the two ribbon cables from the rear chassis (indicated in figure on page 5-14):
 - Ribbon cable to P10 on the Recharger board, from the Digital board.
 - Ribbon cable to P11 on the Recharger board, from the Digital board.



The two halves are sealed by rubber O-ring gaskets that are recessed around the perimeter of the rear chassis. If the gaskets become loose, replace them in the perimeter before re-assembling the monitor.

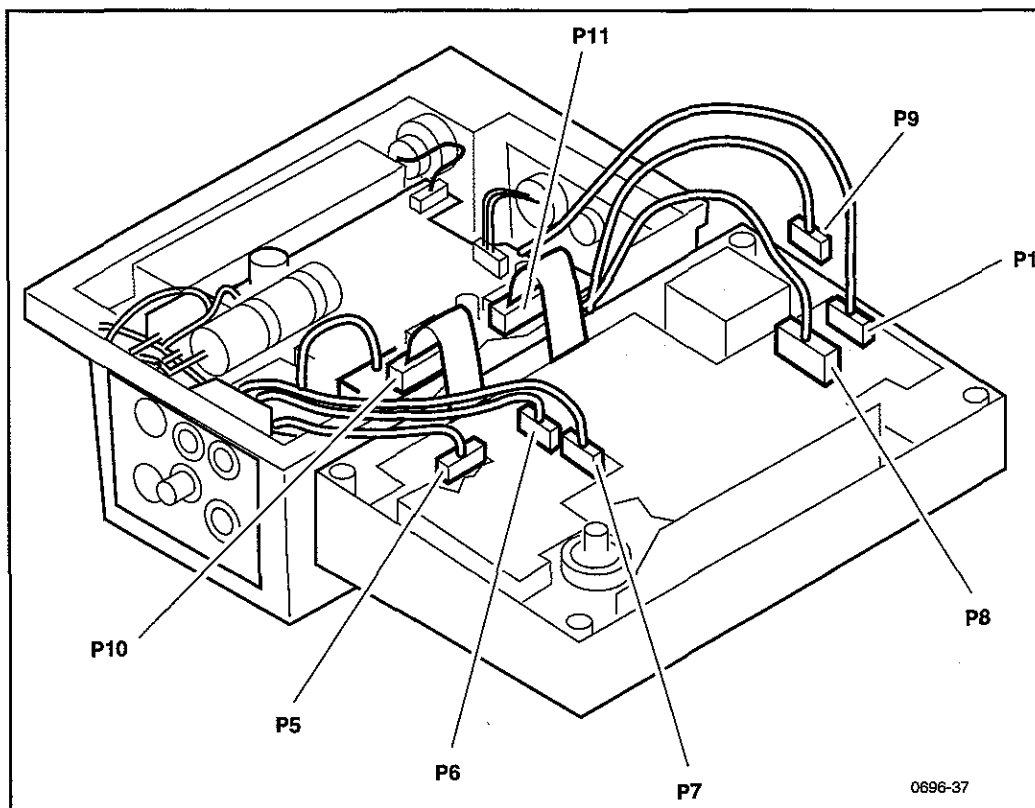
9. Separate the front chassis from the rear chassis (see figure below).



Closing the Monitor

1. Before closing the monitor casing, verify the following:

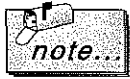
- Cable to P6 on the Analog board goes behind and below the cable to P5, and over the cable to P7.
- Cable to P5 on the Analog board goes over and in front of the cable to P6.
- Cable to P7 on the Analog board goes under the cable to P6.
- Cable to P1 (the expansion cable) must not lay over the transformer.
- Cable to P8 on the Digital board rests to the right of the transformer and over the ribbon cable and cable to P9.
- Cable to P9 lies under the cable to P8.
- All cables and hoses are not pinched.
- The front chassis pressure transducer tube has been securely reconnected.
- The rubber O-ring gasket is in place in the rear chassis.
- Verify that the P10 and P11 locking clips are secure.



2. Torque the six screws securing the front chassis to the rear chassis to 6.65 in-lbs to 7.35 in-lbs (.75 N-m to .83 N-m).

Replacing the Analog Board

If a problem occurs with the Analog board, return the entire monitor to Protocol for service. See Section 1 for information on Technical Service.



Do not remove the PROM from the Analog board.

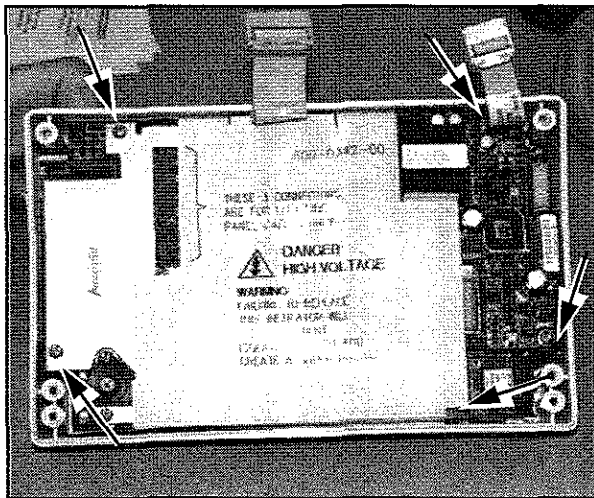
This section provides instructions on removing the Analog board. The Analog board is secured in the front chassis by five screws: three on the right side of the board (side containing the transformer), and two passing through the metal shield on the left side of the board.



You do not need to lift the plastic insulator nor remove the metal shield to remove the Analog board. However, you must lift the insulator to calibrate the board.

1. Remove the battery pack according to the procedures described in on page 5-7.
2. Open the monitor according to the procedure on page 5-11.
3. Remove the five screws fastening the Analog board to the front chassis.

Note that of the five screws, the two longer screws pass through the metal shield to secure the board.

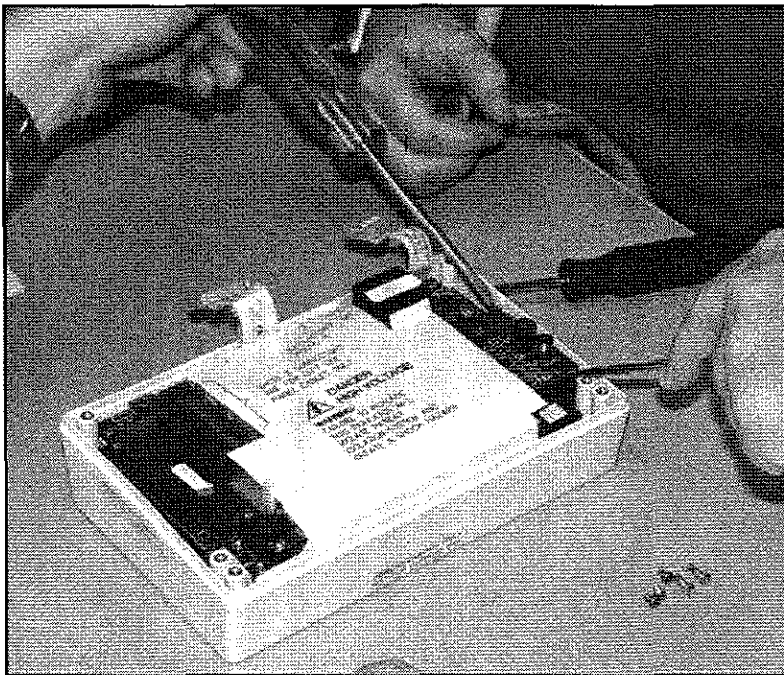




The Analog and Digital boards are connected together on the right side by connectors P4 and J4. It may be necessary to use two flat blade screwdrivers to gently pry the boards apart.

Place the screwdriver blades as close to the edge of the board as possible so you don't contact or disturb components on the board. Components are located as close as 1/8" to the edge of the board. Use extreme caution. Try not to flex the board when prying.

4. Gently lift the Analog board up and out of the front chassis.



When installing the Analog board:

- Blow out any dust and particulates from the board using pressurized de-ionized gas before installing it.
- Align the board so that P4 correctly plugs into J4.
- Torque the screws holding the Analog board to 3.8 in-lbs to 4.2 in-lbs (.43 N-m to .47 N-m).